MAK TECHNOLOGIES

VR-TheWorld Server
Users Guide

Version 3.9.6

ST Engineering North America

MAK Technologies
150 Cambridge Park Drive, 3rd Floor
Cambridge, MA 02140 USA

Voice: 617-876-8085
Fax: 617-876-9208

info@mak.com

www.mak.com

Revision VRW-3.9.6-1-201109

Contents

Preface

This manual is written for persons who will use or administer VR-TheWorld Server.

Please see release documentation for updates to this manual and the latest information about your version of VR-TheWorld Server.

How This Manual is Organized

The chapters are organized as follows:

Chapter 1, *Introduction* introduces you to VR-TheWorld Server.

Chapter 2, *Installing VR-TheWorld Server* explains how to install and setup the VR-TheWorld Server hardware.

Chapter 3, *Configuring VR-TheWorld Server* explains how to configure server and network settings. It also describes how to back up the server.

Chapter 4, *Working with Layers* describes the different types of layers and how to create them.

Chapter 5, *Managing Files* explains how to upload and manage the files that make up a layer.

Chapter 6, *Performance Considerations* explains how you can improve the performance of VR-TheWorld Server.

Appendix A, *Terrain Sources* lists the sources for the data in the layers shipped with VR-TheWorld Server.

Documentation Set

Documentation for VR-TheWorldServer is provided in PDF format, as follows:

- *VR-TheWorldServer Users Guide*. Complete instructions for installing and administering VR-TheWorldServer. You can open this manual by clicking the Documentation link on the VR-TheWorldServer status bar.
- *VR-TheWorldServer First Experience*. An introduction to how to use VR-TheWorldServer in your visualization application.
- *VR-TheWorldServer Quick Start Guide*. Installation instructions.
- *VR-TheWorldServer Release Notes*. Last minute and release-specific information.

MAK Products

The MAK Technologies product line includes the following:

- VR-Link® Network Toolkit. VR-Link is an object-oriented library of C++ functions and definitions that implement the High Level Architecture (HLA) and the Distributed Interactive Simulation (DIS) protocol. VR-Link has built-in support for the RPR FOM and allows you to map to other FOMs. This library minimizes the time and effort required to build and maintain new HLA or DIS-compliant applications, and to integrate such compliance into existing applications.

  VR-Link includes a set of sample debugging applications and their source code. The source code serves as an example of how to use the VR-Link Toolkit to write applications. The executables provide valuable debugging services such as generating a predictable stream of HLA or DIS messages, and displaying the contents of messages transmitted on the network.
- MAK RTI. An RTI (Run-Time Infrastructure) is required to run applications using the High Level Architecture (HLA). The MAK RTI is optimized for high performance. It has an API, RTIspy®, that allows you to extend the RTI using plug-in modules. It also has a graphical user interface (the RTI Assistant) that helps users with configuration tasks and managing federates and federations.
- VR-Forces®. VR-Forces is a computer generated forces application and toolkit. It provides an application with a GUI, that gives you 2D and 3D views of a simulated environment.

  You can create and view entities, aggregate them into hierarchical units, assign tasks, set state parameters, and create plans that have tasks, set statements, and conditional statements. You can simulate using entity-level modeling, which focuses on the actions of individual people and vehicles, and aggregate-level modeling, which focuses on the interaction of large hierarchical units.

  VR-Forces also functions as a plan view display for viewing remote simulation objects taking part in an exercise. Using the toolkit, you can extend the VR-Forces application or create your own application for use with another user interface.

- VR-Vantage™. VR-Vantage is a line of products designed to meet your simulation visualization needs. It includes three end-user applications (VR-Vantage Stealth, VR-Vantage PVD, and VR-Vantage IG) and the VR-Vantage Toolkit.
  - VR-Vantage Stealth displays a realistic, 3D view of your virtual world, a 2D plan view, and an exaggerated reality (XR) view. Together these views provide both situational awareness and the big picture of the simulated world. You can move your viewpoint to any location in the 3D world and can attach it to simulation objects so that it moves as they do.
  - VR-Vantage IG is a configurable desktop image generator (IG) for out the window (OTW) scenes and remote camera views. It has most of the features of the Stealth, but is optimized for its IG function.
  - VR-Vantage PVD provides a 2D plan view display. It gives you the big picture of the simulated world.
  - SensorFX. SensorFX is an enhanced version of VR-Vantage that uses physics based sensors to view terrain and simulation object models that have been materially classified. It is built in partnership with JRM Technologies.
  - The VR-Vantage Toolkit is a 3D visual application development toolkit. Use it to customize or extend MAK's VR-Vantage applications, or to integrate VR-Vantage capabilities into your custom applications. VR-Vantage is built on top of OpenSceneGraph (OSG). The toolkit includes the OSG version used to build VR-Vantage.
- MAK Data Logger. The Data Logger, also called the Logger, can record HLA and DIS exercises and play them back for after-action review. You can play a recorded file at speeds above or below normal and can quickly jump to areas of interest. The Logger has a GUI and a text interface. The Logger API allows you to extend the Logger using plug-in modules or embed the Logger into your own application. The Logger editing features let you merge, trim, and offset Logger recordings.
- VR-Exchange™. VR-Exchange allows simulations that use incompatible communications protocols to interoperate. For example, within the HLA world, using VR-Exchange, federations using the HLA RPR FOM 1.0 can interoperate with simulations using RPR FOM 2.0, or federations using different RTIs can interoperate. VR-Exchange supports HLA, TENA, and DIS translation.
- VR-TheWorld™ Server. VR-TheWorld Server is a simple, yet powerful, web-based streaming terrain server, developed in conjunction with Pelican Mapping. Delivered with a global base map, you can also easily populate it with your own custom source data through a web-based interface. The server can be deployed on private, classified networks to provide streaming terrain data to a variety of simulation and visualization applications behind your firewall.

- DI-Guy™. DI-Guy is an SDK that allows you to embed the DI-Guy library in your real-time application and populate your world with lifelike human characters. DI-Guy provides high-fidelity human characters that move realistically, respond to simple high-level commands, and travel throughout the environment as directed by the hosting visual application. It comes with thousands of ready-to-use characters, appearances, and motions. DI-Guy character simulation is an integral part of all MAK's visual applications, including VR-Engage, VR-Forces, and VR-Vantage.
- RadarFX. RadarFX is a client-server application that simulates synthetic-aperture radar (SAR). The server application, which is based on VR-Vantage and SensorFX, loads a terrain database and, optionally, connects to simulations. A client application requests SAR images from the server. RadarFX includes a sample client application.
- VR-Engage. VR-Engage is a multi-role virtual simulator that lets users play the role of a first person human character, a ground vehicle driver, gunner or commander, a sensor operator, or the pilot of a fixed wing aircraft or helicopter. It incorporates the VR-Force simulation engine and the VR-Vantage graphics rendering capabilities.
- WebLVC Server. WebLVC Server implements the server side of the WebLVC protocol so that web-based simulation federates can participate in a distributed simulation. It is part of the WebLVC Suite, which includes the server and several sample applications that work with VR-Forces and VR-Vantage.

How to Contact Us

For VR-TheWorld Server technical support, information about upgrades, and information about other MAK products, you can contact us in the following ways:

Telephone

Call or fax us at:	Voice:	617-876-8085 (extension 3 for support)
	Fax:	617-876-9208

E-mail

Sales and upgrade information:	info@mak.com
Technical support:	support@mak.com

Internet

MAK web site home page:	www.mak.com
License key requests:	www.mak.com/support/get-licenses
Product version and platform information:	www.mak.com/support/product-versions
For the free, unlicensed MAK RTI:	www.mak.com/support/bonus-material

Post

Send postal correspondence to:	MAK Technologies 150 Cambridge Park Drive, 3rd Floor Cambridge, MA, USA 02140

When requesting support, please tell us the product you are using, the version, and the platform on which you are running.

Document Conventions

This manual uses the following typographic conventions:

`Monospaced`	Indicates commands or values you enter.
`Monospaced Bold`	Indicates a key on the keyboard.
`Monospaced Italic`	Indicates command variables that you replace with appropriate values.
Blue text	A hypertext link to another location in this manual or another manual in the documentation set.
`{ }`	Indicates required arguments.
`[ ]`	Indicates optional arguments.
`|`	Separates options in a command where only one option may be chosen at a time.
(|)	In command syntax, indicates equivalent alternatives for a command-line option, for example, `(-h | --help)`.
/	Indicates a directory. Since MAK products run on both Linux and Windows PC platforms, we use the / (slash) for generic discussions of pathnames. If you are running on a PC, substitute a \ (backslash) when you type pathnames.
Italic	Indicates a file name, pathname, or a class name.
sans Serif	Indicates a parameter or argument.
➤	Indicates a one-step procedure.
Menu → Option	Indicates a menu choice. For example, an instruction to select the Save option from the File menu appears as: Choose **File → Save**.
	Click the icon to run a tutorial video in the default browser.
	Indicates supplemental or clarifying information.
	Indicates additional information that you must observe to ensure the success of a procedure or other task.

Directory names are preceded with dot and slash characters that show their position with respect to the VR-TheWorld Server home directory. For example, the directory *3.9.6/doc* appears in the text as *./doc.*

Mouse Button Naming Conventions

An instruction to click the mouse button, refers to clicking the primary mouse button, usually the left button for right-handed mice and the right button for left-handed mice. The context-sensitive menu, also called a popup menu or right-click menu, refers to the menu displayed when you click the secondary mouse button, usually the right button on right-handed mice and the left button on left-handed mice.

Third Party Licenses

MAK software products may use code from third parties. This section contains summary license information and where required, specific license documentation required by these third parties.

The following libraries are covered by the GNU Lesser General Public License (LGPL) license:

- CIGI
- DevIL
- GEOS
- GStreamer
- LibIconV
- LibWebSockets
- OPCODE
- OpenAL
- OSG
- OsgEarth
- Pthread
- Qt
- Qwt

The following libraries are covered by the ZLib license:

- Bullet Physics
- LibPNG
- LibSDL
- Minizip
- Zlib

The following libraries are covered by the MIT license:

- Expat
- FreeGLUT
- GDAL
- GeoTiff
- HarfBuzz
- LibCURL
- LibSquish
- LibXML
- LUA
- LuaBind
- Proj
- SMHasher
- TCLAP

The following libraries are covered by the BSD license:

- FreeType
- GLEW
- JPEG
- LibTiff
- Protobuf
- PCRE

The following libraries are covered by the commercial licenses:

- FlexLM
- Gameware
- GLStudio
- JRM Technologies SenSimRT and SigSimRT
- OpenFlight
- SpeedTree
- Sundog Triton
- Sundog SilverLining
- CDB API

The following libraries are covered by custom licenses:

- NVidia CG Toolkit
- FreeImage (FreeImage Public License)
- Boost (Boost Software License)
- Poco (Boost Software License)

COLLADA DOM is covered by the SCEA Shared Source license.

Thread Building Blocks is covered by the GPL license:

SQLLite is in the public domain.

Boost License

VR-Link, and all MAK software that uses VR-Link uses some code that is distributed under the Boost License. All header files that contain Boost code are properly attributed. The Boost web site is: www.boost.org.

Boost Software License - Version 1.0 - August 17th, 2003

Permission is hereby granted, free of charge, to any person or organization obtaining a copy of the software and accompanying documentation covered by this license (the "Software") to use, reproduce, display, distribute, execute, and transmit the Software, and to prepare derivative works of the Software, and to permit third-parties to whom the Software is furnished to do so, all subject to the following:

The copyright notices in the Software and this entire statement, including the above license grant, this restriction and the following disclaimer, must be included in all copies of the Software, in whole or in part, and all derivative works of the Software, unless such copies or derivative works are solely in the form of machine-executable object code generated by a source language processor.

THE SOFTWARE IS PROVIDED "AS IS", WITHOUT WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, TITLE AND NON-INFRINGEMENT. IN NO EVENT SHALL THE COPYRIGHT HOLDERS OR ANYONE DISTRIBUTING THE SOFTWARE BE LIABLE FOR ANY DAMAGES OR OTHER LIABILITY, WHETHER IN CONTRACT, TORT OR OTHERWISE, ARISING FROM, OUT OF OR IN CONNECTION WITH THE SOFTWARE OR THE USE OR OTHER DEALINGS IN THE SOFTWARE.

libXML and libICONV

VR-Link and all MAK software that uses VR-Link, links in libXML and libICONV. On some platforms the compiled libraries and header files are distributed with MAK Products. MAK has made no modifications to these libraries. For more information about these libraries please see the following web sites:

- The LGPL license is available at: http://www.gnu.org/licenses/lgpl.html.
- Information about IconV is at: http://www.gnu.org/software/libiconv/.
- Information about LibXML is at: http://xmlsoft.org/.

LizardTech

Portions of this computer program are copyright © 1995-2010 Celartem, Inc., doing business as LizardTech. All rights reserved. MrSID is protected by U.S. Patent No. 5,710,835. Foreign Patents Pending.

1. Introduction

VR-TheWorld Server is MAK's streaming terrain server.

1.1. Introduction to VR-TheWorld Server

VR-TheWorld Server is a simple, yet powerful, web-based streaming terrain server, developed in conjunction with MAK's technology partner, Pelican Mapping. It is delivered with a global base map. However, you can also easily populate it with your own custom source data through a web-based interface. The server can be deployed on private, classified networks to provide streaming terrain data to a variety of simulation and visualization applications behind your firewall.

VR-TheWorld Server has over three terabytes of global elevation, imagery, and feature data — pre-tiled for high performance access. The VR-TheWorld Basemap has:

- Global elevation. 30-meter (DTED Level 2) for the entire globe, based on the CGIAR-CSI version of NASA's SRTM30 dataset, merged with SRTM30Plus bathymetry.
- Global imagery. Landsat 7 (15m resolution for the entire globe) merged with NASA Blue Marble data (500m resolution), color-corrected for seamless display, and pre-tiled to 7 mipmap levels.
- High-resolution inset areas. The insets range from 1m to 15cm per pixel – including Boston, Washington, D. C., and two airport areas in Afghanistan.
- Samples of 1:250,000 and 1:100,000 topographic maps in Southern California.
- Highly detailed California map with 2ft or better imagery.
- Landcover: Globe Cover 2009 plus insets for US, California and Hawaii.
- Open Street Map dated 4/16/2020.
- A highly detailed map of Hawaii, which includes:
  - 15m Harris Terracolor imagery, added to make the area surrounding the Hawaiian Islands look more like deep blue water. This product has a very nice view of the shallow water boundaries between the ocean and the islands.
  - 1ft USGS Mosaicked Digital Orthophoto Quadrangles (MDOQs) produced through the National Digital Orthophoto Program (NDOP) for the island of Oahu.
  - 1ft water replacement imagery custom built by Harris, includes Digital Globe WV2 Imagery blended into Oahu Imagery and Harris Terracolor Imagery to ease the transition between the 15m and 1ft imagery.
  - 10m Digital Elevation Model from USGS.
  - Feature data for Oahu, including building footprints for 120,000 buildings.

VR-TheWorld Server uses open standards such as WMS-C (Web Mapping Service-Cached, from Open Geospatial Consortium) and WFS (Web Feature Service, from the Open Geospatial Consortium). This means that clients are not limited to MAK's visualization or simulation tools. Any customer or third party application that supports WMS-C (including web applications) can access VR-TheWorld Server immediately.

2. Installing VR-TheWorld Server

This chapter explains how to install the VR-TheWorld Server.

2.1. Installing VR-TheWorld Server Software and Data

VR-TheWorldServer is built on the Docker platform. This allows you to use Linux or Windows as platforms to run VR-TheWorldServer.

A VR-TheWorldServer installation has the following software and hardware components:

- Docker. A web-based application used to deliver the VR-TheWorld Server database structure and data.
- VR-TheWorldServer software.
- VR-TheWorldServer database structure and data files. The database provided by MAK is optional. You can create your own database and use your own data files. You can also add your data files to those provided by MAK.
- Hard drive. MAK provides a hard drive with installation scripts and data files.

The minimum recommended hardware configuration for running VR-TheWorld Server is:

- Server:
  - Quad core
  - 32 GB RAM
  - 250 GB hard drive
- Data storage:
  - 4 TB of usable space (after configuration).
- Operating system:
  - Red Hat 7
  - CentOS 7
  - Windows 10

Installing and configuring Docker on Windows requires changes to your system's BIOS as well as Windows features. Please follow the instructions closely.

2.1.1. Considerations for Using Docker

This section discusses the following issues that you may need to consider when using Docker:

- Ports.
- Handling crashes and reboots.
- Path syntax.

Ports

Docker does not bypass firewalls. It creates rules inside the kernel to redirect traffic that comes to the host. The *docker-compose* file lists the ports that are being used in the following format:

```
host_port : docker_port
```

By default, Docker exposes container ports to the IP address 0.0.0.0. (This matches any IP on the system). If you want to, you can tell Docker which IP address to bind on. For example, to bind on localhost port 80 and container port 8080, you would specify:

```
127.0.0.1:80:8080
```

Some customers may prefer this for security reasons. Otherwise, that host port becomes open to all incoming connections.

Handling Crashes and Reboots

You can implement a restart policy for your Docker container that will prevent the need for you to manually restart the containers in the case of a crash or reboot.

This is done through the **`--restart`** argument, which can be called within the docker **`run`** command or the docker **`update`** command (once containers are running). For our case, the docker **`update`** command makes more sense, because the docker **`run`** command is not called explicitly during the installation process.

Here is how to set this for a single container:

```
docker update --restart unless-stopped container_name
```

Here is how to set this for all containers:

```
docker update --restart unless-stopped $(docker ps -q)
```

tab lists the potential values for the **`--restart`** flag. **`unless-stopped`** is the most commonly used value. It is designed for the use case of handling a server crash / reboot.

Table 2-1:

Command	Description
no	Default value - containers would not be restarted.
on failure	Restarts container in the case of an error (container crashes).
always	Always restart container if it stops.
unless-stopped	Always restart container unless it is manually stopped.

Specifying Paths in Docker

Declare all paths using a forward slash (/), not the Windows-standard backslash (\). Items are appended to Docker paths following a Unix format, and when a path mixes backslashes with forward slashes it becomes invalid. If you want to declare the paths in a Windows format, set the COMPOSE_CONVERT_WINDOWS_PATHS environment variable to 1.

2.2. Installing VR-TheWorldServer on Linux

This section explains how to install VR-TheWorldServer on Linux operating systems.

2.2.1. Setting Up Your Computer

Variations in Linux systems may create problems installing Docker and running VR-TheWorldServer. Please review the issues discussed in this section to ensure that your system is properly set up.

Partition Setup

It is recommended that you configure */etc/fstab* to point to drives by UUID. If drives are not configured by UUID, the mount locations or order of the drivers might change after you restart the server.

Partitions should use the XFS scheme. Non-XFS partitions may experience problems when copying the contents of the external drive to the internal drive.

Installing Docker on CentOS 8

CentOS has some packages that affect container behavior. Use the **`yum autoremove`** command to remove the podman and buildah packages.

2.2.2. Installing Docker

Download and install Docker. Follow the instructions at https://docs.docker.com/engine/install/

Install docker-compose

Install docker-compose as follows:

```
sudo curl -L "https://github.com/docker/com-
  pose/releases/download/1.27.4/docker-compose-$(
  uname -s)-$(uname -m)"
  -o /usr/local/bin/docker-compose
```

1.27.4 is the version of docker-compose in this example. If you are installing a different version, use that version number.

Configure the Firewall

Firewall settings may restrict the usage of certain ports through docker.

To set up the firewall:

1. Find out which zone the docker interface it bound to, most likely “no zone”:

   ```
   sudo firewall-cmd --get-zone-of-interface=docker0
   ```

2. Add the docker0 interface to the public zone. Changes will be visible only after firewalld reloads:

   ```
   sudo nmcli connection modify docker0 connection.zone public
   ```

3. Add masquerading, which allows for docker ingress and egress:

   ```
   sudo firewall-cmd --zone=public --add-masquerade --perma-
     nent
   ```

4. Reload firewalld:

   ```
   sudo firewall-cmd --reload
   ```

5. Reload dockerd:

   ```
   sudo systemctl restart docker
   ```

2.2.3. Installing the Data Drive

You must mount the data drive and create the installation directory. The drive is in XFS format.

To mount the data drive:

1. The data drive has a USB connection. Attach it to a USB 3.0 port on your computer.

2. Issue the following command to get the location of the drive:

   ```
   sudo fdisk -l
   ```

   This lists all the drives connected to the computer. The MAK data drive is called */dev/sd**, where * is a letter from a-z). The data drive size is 6000GBs. Write down the name of the MAK drive.

3. Create the data directory:

   ```
   sudo mkdir -p /data
   ```

2.2.4. Copy Data or Mount the Data Drive

You can run VR-TheWorldServer from the data drive or copy the data to your computer's hard drive. For best performance, MAK recommends that you copy the data to your computer's hard drive.

➤ To copy the contents of the MAK data drive to an internal drive, run the following command:

```
xfsdump -J - /dev/NAMEOFDRIVE | xfsrestore -J - /data
```

where *NAMEOFDRIVE* is the name you recorded when you got the location of the disk.

- Copying the data takes 8-10 hours. Do not interrupt the process.
- Partitions should use the XFS scheme. Non-XFS partitions may experience problems when copying the contents of the external drive to the internal drive.

➤ If you choose to run VR-TheWorldServer from the data drive, rather than copying data, mount the data drive to /data, as follows:

```
sudo mount /dev/NAMEOFDRIVE /data
```

where *NAMEOFDRIVE* is the name you recorded when you got the location of the disk.

2.2.5. Installing VR-TheWorldServer

VR-TheWorldServer organizes data into layers, which reference the data files. You must install the database structure. You can do so automatically or manually.

To install VR-TheWorldServer:

1. Change directory to the install directory:

   ```
   cd /data/VRTheWorld
   ```

2. Optionally, edit the settings file, *docker-compose.yml*. The file is commented to explain the options. (For more information, please see .)

   ```
   vim docker-compose.yml
   ```

3. Load the images for VR-TheWorldServer (you must have elevated permissions to run these commands):

   ```
   docker load < postgis_9.5-alpine.tar.gz
   docker load < redis_3.2-alpine.tar.gz
   docker load < vrtheworld_VERSIONOFVRTW.tar.gz
   ```

   where *VERSIONOFVRTW* is the version of VR-TheWorldServer you are installing.

4. Start VR-TheWorldServer:

   ```
   docker-compose up -d
   ```

You can now access VR-TheWorldServer using its IP address. The default username and password is **`readymap`**.

Configuration Options for Docker

In the *docker-compose.yml* file, you can pass optional arguments to our docker container to increase your VR-TheWorldServer performance. These are defined in the optional environment section of the file. Table 2-2 describes the environment variables.

Table 2-2: Docker environment variables

Variable	Description
NUM_WORKERS	The number of background workers started for processing general background tasks.
NUM_TILERS	The number of background workers started for seeding map tiles via cache jobs.
NUM_TILE_GENERATORS	The number of background workers started for generating map tiles on demand.
GENERATE_TILES_IN_BACKGROUND_WORKER	Whether to generate tiles on demand in a background process or in the main apache process. By default, tiles ae generated in a background process to avoid bogging down the server during periods of high load. Set this environment variable to False to restore the original behavior of generating tiles in the main apache process.
USE_LAYER_NAMES	When set to True, VR-TheWorldServer will expose layers using their name instead of their ID in GIS services. This could make switching between VR-TheWorldServer servers that have similar layer names easier when configuring earth files.

To set environment variables in *docker-compose.yml*, read the instructions at this link: https://docs.docker.com/compose/compose-file/#environment

2.2.6. Installing the MAK-Supplied Database

VR-TheWorldServer does not presume any particular data. You can load your own database or the database supplied by MAK. If you are using MAK applications such as VR-Vantage or VR-Forces, the terrain database files provided with these applications presume use of the MAK database structure and data files.

This section explains how to load the MAK database.

If you load the MAK database using a script, it removes all of the currently installed data from the server.

To install the MAK database:

1. Change directory to the VR-TheWorldServer install directory:

   ```
   cd /data/VRTheWorld
   ```

2. Shut down the docker containers and restart them:

   ```
   docker-compose down
   docker-compose up -d
   ```

3. Load the database into readymap:

   ```
   docker-compose exec readymap readymap_restore /data/back-
     ups/vrtw3.db
   ```

Once the installation process is complete, you can log into the web interface of VR-TheWorldServer. The default username and password is **`admin`**.

2.3. Installing VR-TheWorldServer on Windows

This section explains how to install VR-TheWorldServer on Windows.

2.3.1. Prerequisites for Using Docker

To use Docker on Windows, you must enable virtualization, WSL2 (Windows Subsystem for Linux), and Hyper-V. These are all capabilities that are built into Windows 10, but which might not be enabled.

To check the status of virtualization:

1. Open Task Manager.
2. Select the Performance tab.
3. The status of virtualization is displayed under the graph (Figure 2-1).

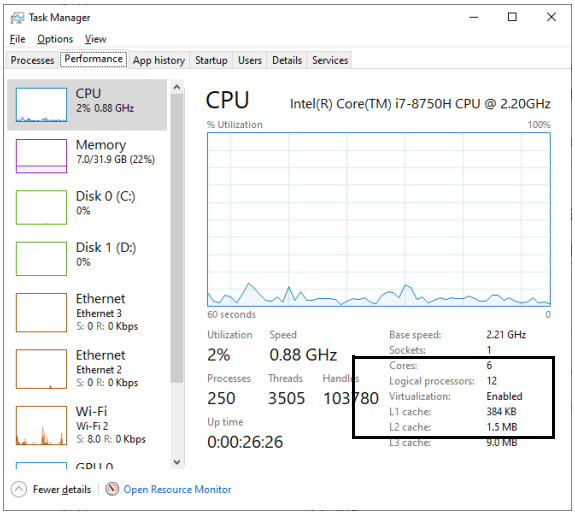

Figure 2-1. Task Manager, Performance tab

If virtualization is not enabled, you must enable it. Instructions for doing so are readily available using an internet search.

To enable Hyper-V and WSL2

1. Right-click the Start menu icon and select Search.
2. In the Search box, type Windows Features. The search results shows Turn Windows Features On or Off as the best match.
3. Click Turn Windows Features On or Off. The Windows Features dialog box opens (Figure 2-2).

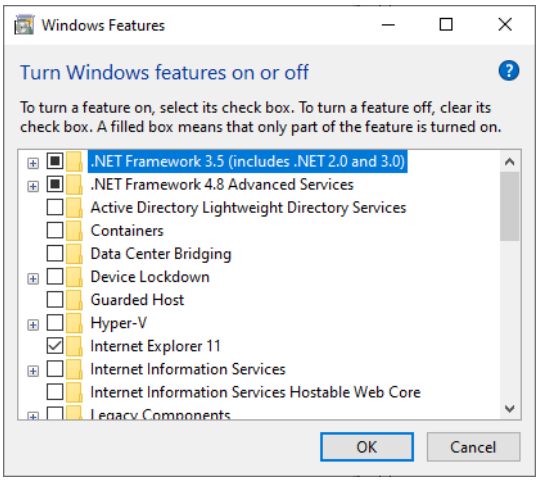

Figure 2-2. Windows Features

4. Select the check box next to Hyper-V.
5. Select the check box next to Windows Subsystem for Linux.

2.3.2. Installing Docker

Download and install Docker. Follow the instructions at https://docs.docker.com/docker-for-windows/install/

2.3.3. Attach the Data Drive and Copy Data

The drive provided by MAK for Windows is in NTFS format.

To attach the data drive and copy the data:

1. Plug the USB cable from the data drive into a USB 3.0 port on your machine.
2. Open a console window.
3. Enter:

   ```
   diskmgmt.msc
   ```

   The screen displays a list of all the drives connected to the system.
4. Write down the letter of the data drive provided.
5. In Windows File Explorer, create a directory (folder) called **`data`** on the target drive. VR-TheWorldServer will use this directory to store all the files it needs to use.
6. Copy the data from the source directory to your data directory.

2.3.4. Installing VR-TheWorldServer

You can pass optional arguments to our docker container to increase your VR-TheWorldServer performance. These are defined in the optional environment section of the file. Table 2-2 describes the environment variables.

To install VR-TheWorldServer on Windows:

1. Open a console window.
2. Change directory to the data drive:

   ```
   cd DATADRIVE:\data\VRTheWorld
   ```
3. In a text editor, open *docker-compose-windows.yml*.
4. Copy all of the content in the file.
5. In a text editor, open *docker-compose.yml*.
6. Replace all of the content with the content you copied from *docker-compose-windows.yml*. (VR-TheWorldServer includes configurations for Linux and Windows. However, Docker only looks for *docker-compose.yml*, so you have to replace the Linux configuration information with the Windows configuration.)
7. Examine the content of the file. If there are an backslashes (\), replace them with forward slashes (/).
8. In lines 15 and 16, replace DATADRIVE with the drive letter on which the data is installed.
9. Save the file and close it.

10. In your console window, in DATADRIVE:\data\VRTheWorld, execute the following commands:

    ```
    docker load -i postgis_9.5-alpine.tar.gz
    docker load -i redis_3.2-alpine.tar.gz
    docker load -i vrtheworld_VERSIONOFVRTW.tar.gz
    ```

    where VERSIONOFVRTW is the version of VR-TheWorldServer that you are installing.

11. Start VR-TheWorldServer:

    ```
    docker-compose up -d
    ```

    You can now access VR-TheWorldServer using its IP address. The default username and password is **`readymap`**.

2.3.5. Installing the MAK-Supplied Database

VR-TheWorldServer does not presume any particular data. You can load your own database or the database supplied by MAK. If you are using MAK applications such as VR-Vantage or VR-Forces, the terrain database files provided with these applications presume use of the MAK database structure and data files.

This section explains how to load the MAK database.

If you load the MAK database using a script, it removes all of the currently installed data from the server.

To install the MAK database:

1. Change directory to the VR-TheWorldServer install directory:

   ```
   cd DATADRIVE:\data\VRTheWorld
   ```

2. Shut down the docker containers and restart them:

   ```
   docker-compose down
   docker-compose up -d
   ```

3. Copy *vrtw3.db* to the */data/added* directory. (Docker will see this as */data/vrtw3.db* because our default mount location is */data/added*, as configured by the *docker.yml* file.)

4. Load the database into readymap (this will take 5 to 10 minutes):

   ```
   docker-compose exec readymap readymap_restore
     /data/vrtw3.db
   ```

Once the installation process is complete, you can log into the web interface of VR-TheWorldServer. The default username and password is **`admin`**.

2.4. Troubleshooting Installation Problems

The installation scripts create log files. If you have problems installing VR-TheWorldServer 3.0, please email support@mak.com and include the log files with a description of the problem.

2.5. Upgrading to VR-TheWorldServer 3.0 from Previous Versions

We recommend dedicating new hardware to run VR-TheWorldServer 3.0 due to incompatibility with previous versions. If you want to use data from a previous version of VR-TheWorldServer, you must copy the data from your old server to your new server. There is no way to reuse your database from previous versions of VR-TheWorldServer with VR-TheWorldServer 3.0. You must manually enter layers and upload their data to VR-TheWorldServer 3.0.

If you want to upgrade a server running a previous version of VR-TheWorld-Server, you must save the data currently attached to your VR-TheWorldServer server and back up your database to an external hard drive. Then, install a new Linux operating system (Centos7 or Redhat7). This ensures that previous installations of VR-TheWorldServer will not interfere with the upgraded image. After successfully installing a new operating system, please follow the instructions to install VR-TheWorldServer 3.0.

2.6. Connecting to a MAK-Supplied Server

If you have a server that was provided by MAK, VR-TheWorld Server is configured to use DHCP and it has a static IP address. If your network has dynamic DNS set up, you can connect to the server without further configuration. If you do not have dynamic DNS, you must configure an IP address for the server.

- For web connections, the default user is admin. The default password is admin. You can change these passwords.
- VR-TheWorldServer does not work with Internet Explorer. Use Firefox, Chrome, or Edge.

2.6.1. Connecting to VR-TheWorld Server Using Dynamic DNS

To connect to the server using dynamic DNS:

1. Set up the server and connect it to the network.
2. Open a web browser.
3. Point the browser to http://localhost/vr-theworld.

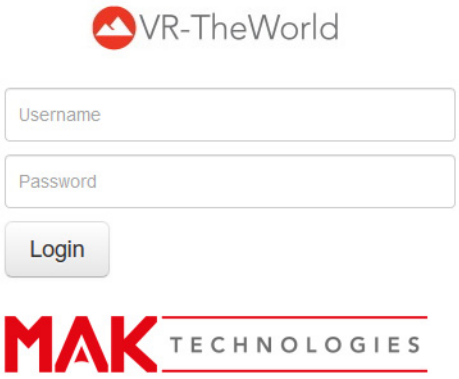

Figure 2-3. VR-TheWorld Server

4. Click admin in the upper right corner of the window. The default user is admin. The default password is admin. It is recommended that you change the password the first time you log in.
5. Configure the server, as described in Chapter 3, *Configuring VR-TheWorld Server*.

3. Configuring VR-TheWorld Server

This chapter describes basic configuration and server management tasks.

3.1. Introduction

VR-TheWorld Server administrators configure VR-TheWorld Server through the browser interface.

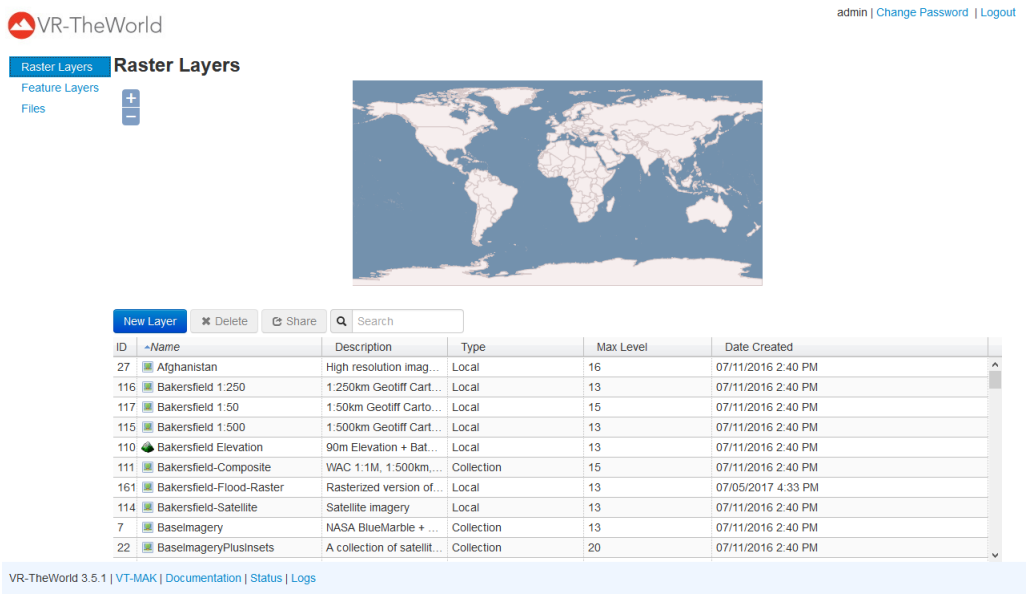

Figure 3-1. VR-TheWorld Server administrator view

3.2. Logging In to VR-TheWorld Server

To log in to the server:

1. Open a web browser.
2. Point the browser to http://vr-theworld.

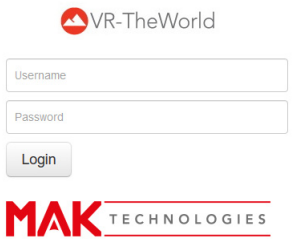

Figure 3-2. VR-TheWorld Server

3. The default username is admin. The default password is admin. It is recommended that you change the password the first time you log in.
4. Configure the server, as described in the rest of this chapter.

3.2.1. Changing the Admin Password

To change the admin password:

1. Log in to VR-TheWorld Server.
2. In the upper right corner, click Change password. The Change password page opens.
3. Optionally, edit the user name.
4. Type the current password.
5. Type the new password and confirm it.
6. Click Save.

3.2.2. Logging Out of VR-TheWorld Server

➤ To log out of VR-TheWorld Server, in the upper right corner of the window, click Logout.

4. Working with Layers

This chapter describes how to create and edit layers.

4.1. Layers

VR-TheWorld Server supports raster layers and feature layers. Raster layers can contain image data or elevation data. Feature layers contain feature data.

4.2. Creating and Editing Raster Layers

VR-TheWorld Server supports the following types of raster layers:

- Local layer. A local layer uses the files on the server.
- Remote layer. A remote layer connects to another file server and makes it seem as if the files are coming from VR-TheWorld Server.
- Composite layer. A composite layer is a layer that is made up of other layers. Composite layers are more configurable than other layers. Composite layers may improve performance because there is one place to look for all the required data.

Layers are made up of files. In addition to the files provided with VR-TheWorld Server, you can upload your own data for storage on the server. Image files must be georeferenced, such as GeoTIFFs.

4.2.1. Creating a Raster Layer

You can create the following types of raster layers:

- Local. A local layer.
- WMS. A remote layer.
- Collection. A composite layer.
- Temporal. A time series of multiple layers.
- XYZ. Uses proxy data from a tile imagery service using a URL template.

To create a raster layer:

1. Connect to VR-TheWorld Server.
2. Log in as administrator.
3. Select the Raster Layers tab.

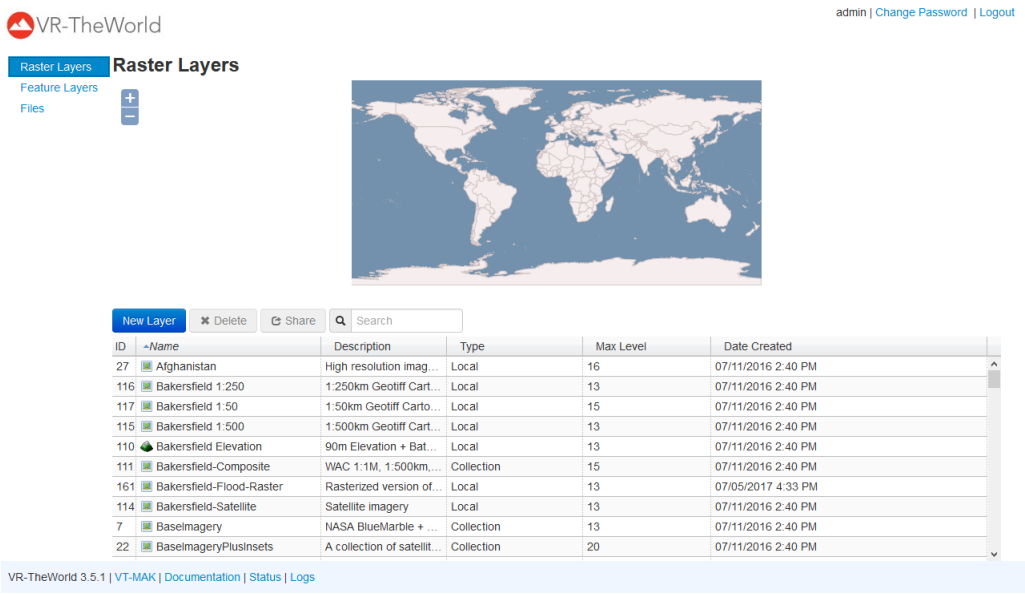

Figure 4-1. Raster Layers tab

4. Click New Layer. The Create Layer window opens (Figure 4-2), It lists the types of layers you can create, with brief descriptions.

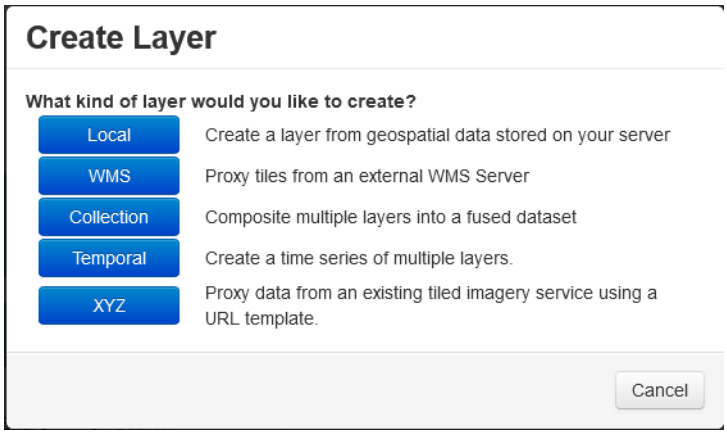

Figure 4-2. Create Layer window

5. Click the button for the type of layer you want to create. The browser displays a layer creation wizard for the layer.

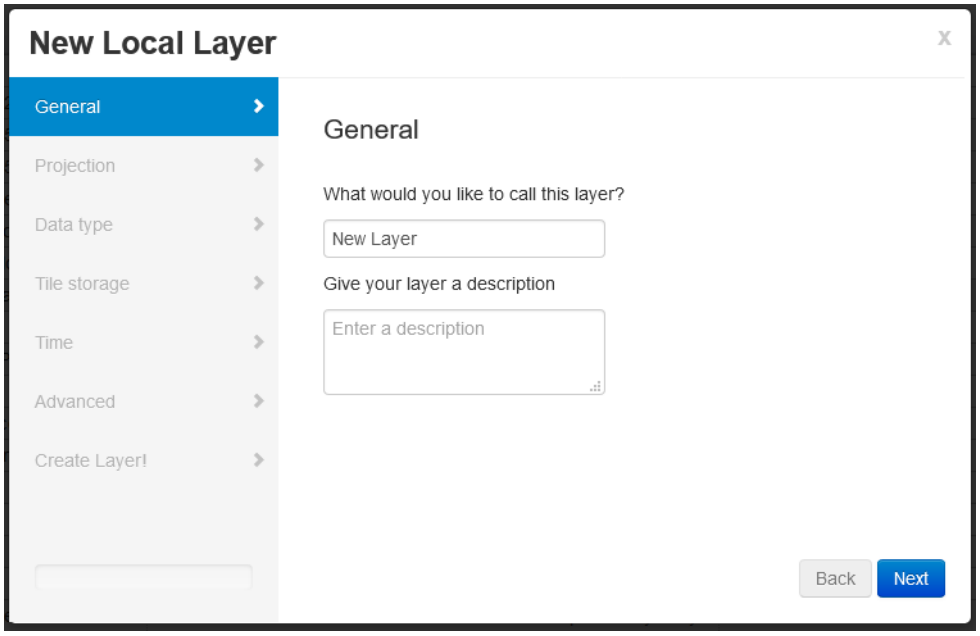

Figure 4-3. Edit local image layer

6. Fill in the attributes for the layer. After you complete each page, click Next. For details about the attributes of each layer type, please see "Layer Attributes," on page 4-5.
7. If you are creating a composite layer, add layers.
8. Click Submit.

4.2.2. Layer Attributes

The different layer types share several common attributes. Table 4-1 lists the common attributes and the layer specific attributes.

Table 4-1: Layer attributes

Wizard Page	Applicable Layer	Attribute
General	All	Name. Description.
Projection	All	Geodetic or spherical mercator
Data type	Local, Temporal	Imagery or elevation.
Tile Storage	Local, Collection, Mapnik, MapServer	PNG, JPEG, TIFF, or Cesium Quantized Mesh (local layer only)
Time	Local	The time the data was collected. Local layer only.
Advanced	Local	Resampling algorithm: Nearest, Bilinear, or Average
WMS Information	WMS	URL for the service. Layers to proxy. Imagery format. Tile size. Styles.
Template Information	XYZ	URL for the template.

4.2.3. Adding Files to a Local Layer

A layer is made up of one or more files. The files are listed when you edit a layer. You can add files to a layer.

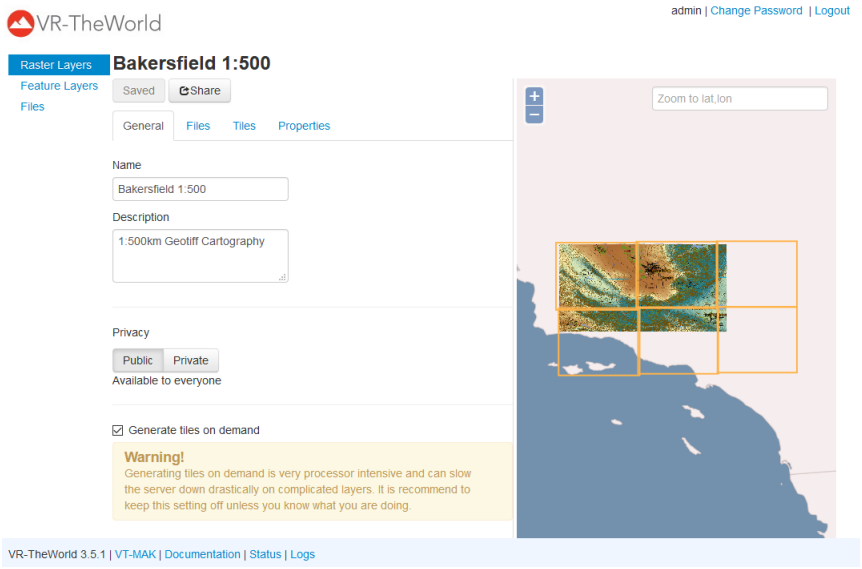

Figure 4-4. Layer file list

To add files to a local layer:

1. Enter Edit mode as follows:
   a. Select the Raster Layers list.
   b. Double-click the layer you want to edit.
2. Click the Files tab.
3. Above the file list, click the Plus button (Figure 4-5). The Select a File dialog box opens.

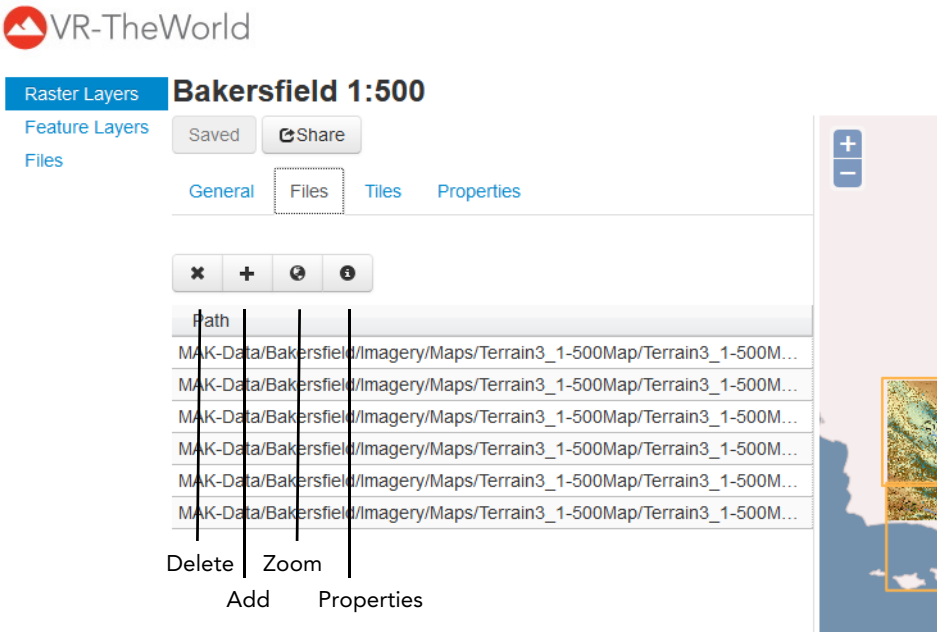

Figure 4-5. File management toolbar

4. Select the file you want to add or select a directory from which you want to add all files.
5. Click OK. The files are added to the layer.
6. Add more files as desired.
7. Save the layer.

4.2.4. Zooming to a File

When you view a layer, you can quickly zoom in to the location of each file.

To zoom to a file:

1. Enter Edit mode as follows:
   a. Select the Raster Layers list.
   b. Double-click the layer you want to edit.
2. Click the Files tab.
3. Select the file that you want to zoom to.
4. Click the Zoom to File button (Figure 4-5).

4.2.5. Viewing the Properties of a File

You can display the properties of the files in a raster layer.

To display file properties:

1. Enter Edit mode as follows:
   a. Select the Raster Layers list.
   b. Double-click the layer you want to edit.
2. Click the Files tab.
3. Select the file that you want to view.
4. Click the Properties button (Figure 4-5).

4.2.6. Viewing Elevation Layers

When you display an elevation layer, VR-TheWorldServer colors the layer based on the elevation (Figure 4-6).

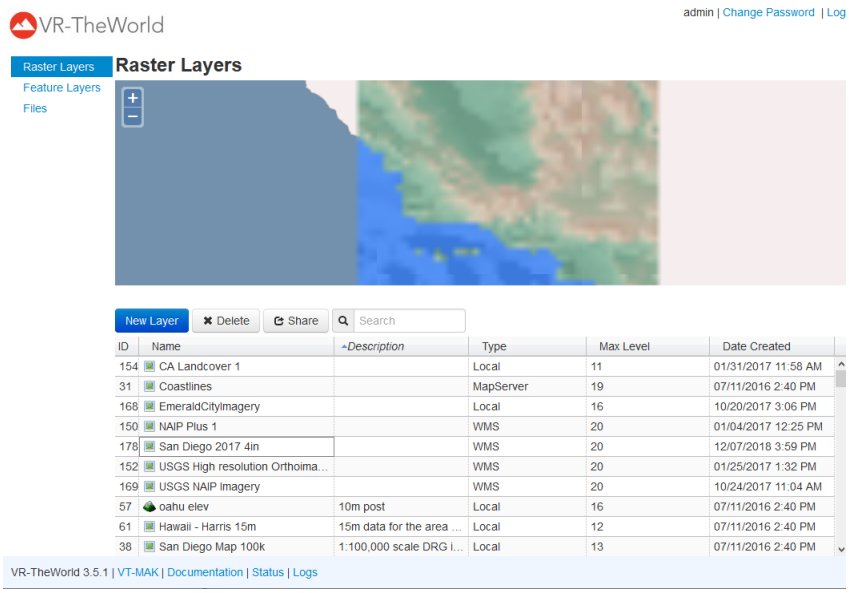

Figure 4-6. Coloring by elevation

4.2.7. Deleting Files from a Local Layer

To delete files from a local layer:

1. Enter Edit mode as follows:
   a. Select the Raster Layers list.
   b. Double-click the layer you want to edit.

> You can also enter Edit mode by selecting a Raster Layer on the Overview tab and clicking the Edit button.

2. Click the Files tab.
3. In the file list, select the file you want to delete.
4. Above the file list, click the X button (Figure 4-5). A confirmation dialog box opens.
5. Click OK.
6. Save the layer.

4.2.8. Adding Layers to a Composite (Collection) Layer

A composite layer is made up of one or more layers. Therefore, when you create a composite layer, you must specify the layers that it contains. You can change the order of layers in a composite layer and you can delete layers, as described in "Changing the Order of Layers on a Map," on page 5-7 and "Removing Layers from a Map," on page 5-8.

To add layers to a composite layer:

1. Select the Raster Layers tab.
2. Create a new composite layer or double-click an existing composite layer to enter Edit mode.
3. Select the Layers tab.

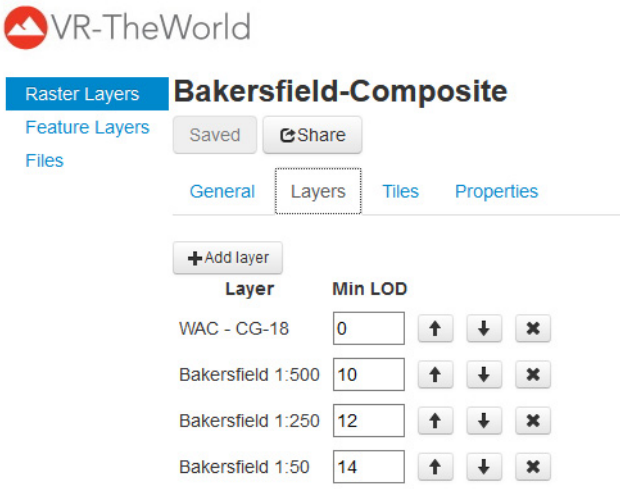

Figure 4-7. Layers tab

4. Click the Add Layer button. The Select Layer dialog box opens.
5. Select a layer in the list.
6. Click OK.

4.2.9. Changing the View of a Layer

When you are editing a layer, you have the following options for changing the view of the layer:

- Zoom
- Pan
- Jump to latitude/longitude.

Zooming the View of a Layer

To zoom the view of a layer, use one of the following methods:

- Hold down the **Shift** key and drag a bounding box around the area you want to zoom in on.
- Move the scroll wheel on your mouse forward or backward.
- Click one of the zoom controls.
- Type latitude and longitude values in the Zoom to lat, lon text box.

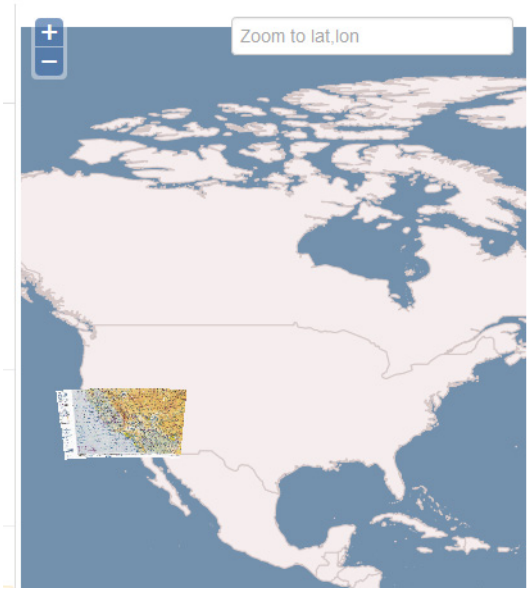

Figure 4-8. Pan and zoom controls

Panning the View of a Layer

➤ To pan the view of a layer, left-click and drag the map.

4.2.10. Tiling Raster Layers

All of the data served by VR-TheWorld Server is tiled. Tiling is the process of splitting large images into small images for fast loading and viewing within different terrain extents and levels-of-detail (LODs).

To tile a raster layer:

1. Select the Raster Layers page.
2. Double-click the layer you want to tile.
3. Select the Tiles tab.
4. Click Publish Layer.

Deleting Tiles

You cannot delete individual tiles. You can delete all of the tiles in a layer.

To delete the tiles in a raster layer:

1. Select the Raster Layers page.
2. Double-click the layer whose tiles you want to delete.
3. Select the Tiles tab.
4. Click Delete All Tiles.

4.2.11. Caching the Current View of Tiles

Caching data can improve performance for subsequent views.

To cache the current view of a raster layer:

1. Select the Raster Layers page.
2. Double-click the layer whose tiles you want to delete.
3. Select the Tiles tab.
4. Click the Cache Current View button. The Cache Layer dialog box opens .

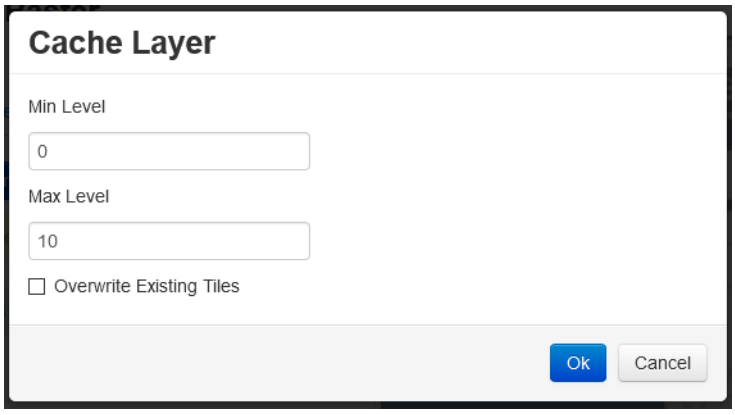

Figure 4-9. Cach Layer dialog box

5. Specify the minimum and maximum layers to cache.
6. If you want to overwrite existing cached tiles, select the Overwrite Existing Tiles check box.
7. Click OK.

4.3. Creating and Editing Feature Layers

Feature layers allow you to add streaming features to your terrain. Feature data is contained in shapefiles (*.shp*).

To create a feature layer:

1. Select the Feature Layers tab.

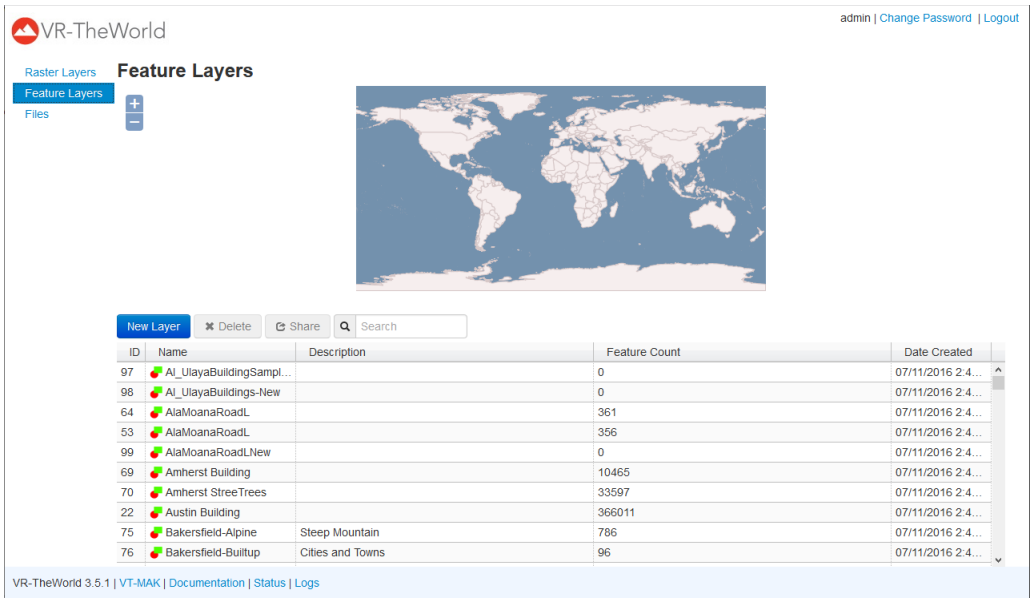

Figure 4-10. Feature layer tab

2. Click New Layer. The New Feature Layer screen is displayed.
3. On the General page, type a name for the layer.
4. Optionally, type a description.
5. Click Next. The wizard displays the Select File page.
6. Select a file for this layer. The Layer field gets filled in from data in the file.
7. Click Next. The wizard displays the Create Layer! page.
8. Click Submit.

4.3.1. Editing a Feature Layer

You can change the name and description of a feature layer. You can also specify parameters for tiling it. You cannot change the properties.

To edit a feature layer:

1. Select the Feature Layers page.
2. Double-click the feature layer that you want to edit. Information about the layer is displayed.

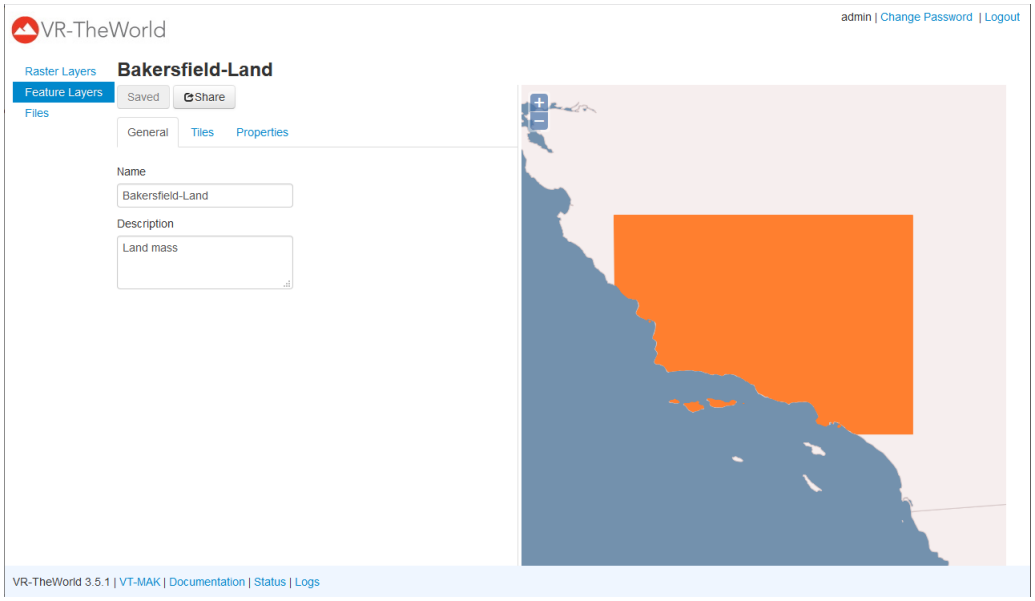

Figure 4-11. Feature layer selected

3. Click the Edit button. The Edit panel is displayed.
4. Change the name or description.
5. Click Save.

4.3.2. Tiling Feature Layers

You can create tiles for the Tiling Feature Service (TFS). Tiling a feature layer serves a different purpose than tiling raster layers. When you tile a feature layer you specify the order in which features are loaded. For example, you could specify that features above a certain height get loaded first, so that as you approach a city, the skyline becomes visible before smaller buildings do. If you do not tile a feature layer, features get loaded randomly, which may not provide the ideal visual experience.

Feature tiling is optional.

The feature tiling generates a quadtree that starts with a single tile that encompasses the bounds of the entire feature dataset. The Max Features option is the maximum number of features to place in a quadtree tile. So if you pick 500 and sort by 'height', the tallest 500 buildings go into the first cell, then the next tallest 500 (in each child cell) are placed, and so on.

The First Level specifies the first level in the quadtree that features actually start to appear. For example, if you had a worldwide shapefile of buildings, you do not really need the tallest 500 buildings in the world to appear at a global view. If you picked level 10 as your first level you would not see buildings start to appear until you zoomed down close enough for level 10 to be visible.

The units list allows you to specify the first level in different ways. If you pick LOD, you are picking an explicit level in the quadtree. If you pick meters or Km you are telling it to pick a level that would be visible at that viewing distance. For example, if you specify First Level as 5 and choose Km in the list, you are picking a level of detail that is appropriate for a viewing distance of 5 Km.

To tile a feature layer:

1. Select the Feature Layers page.
2. Double-click the feature layer that you want to tile.
3. Select the Tiles tab.
4. Click Tile Layer. The Tile Layer dialog box opens.

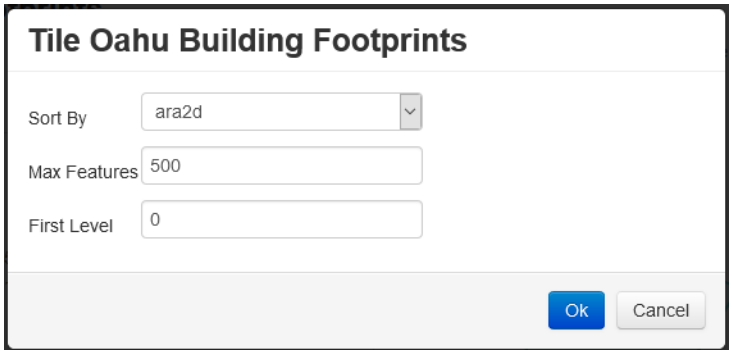

Figure 4-12. Tile feature layer dialog box

5. In the Sort By drop-down list, select the attribute to sort by.
6. In the Max Features box, specify the maximum number of features to place in a quadtree tile.
7. In the First Level box, specify the first level in the quadtree at which features start to appear.
8. Click OK.

4.4. Viewing the Properties of a Layer

You can view the properties of a raster layer or feature layer.

To view the properties of a layer:

1. Select the Raster Layers page or Feature Layers page.
2. Double-click the layer whose properties you want to view.
3. Select the Properties tab.

4.5. Searching Layers

You can search for a specific layer using any text string that is part of the ID, Name, Description, or Type columns. You can also sort the columns for clicking the column name.

➤ To search for a layer, type a text string in the Search field.

4.6. Deleting a Layer

This procedure applies to raster layers and feature layers.

To delete a layer:

1. Select the Raster Layers or Feature Layers page.
2. Select the layer you want to delete.
3. Click the Delete button. A confirmation dialog box opens.
4. Click OK.

5. Managing Files

This chapter describes how to manage the files on the server.

5.1. Managing Files

VR-TheWorld Server has almost 4 TB of terrain data. You may have additional terrain data that you want to serve using VR-TheWorld Server. You can add your data to the server to make it available through VR-TheWorld Server.

VR-TheWorld Server supports the following raster file formats:

- MRSID
- GDAL virtual
- Geotiff
- JPEG 2000
- DEM
- DTED 0 - 5
- Arcinfo Binary Grid
- Magellan BLX Topo
- Bathymetry Attributed Grid
- VTP Binary terrain format
- USGS DOQ
- ESRI *.hdr*
- Envisat Image Product
- ERMapper
- FITS
- Erdas Imagine
- National Imagery Transport Files (CIB, CADRG, and so on)
- BSB Nautical chart format

VR-TheWorld Server supports the following vector file formats:

- Shape
- KML
- GPX
- VMAP
- S-57

5.2. Creating a Folder

VR-TheWorld Server stores files in folders (directories). You can create new folders for your data or store data in existing folders.

To create a folder:

1. Log in as administrator.
2. Select the Files page.

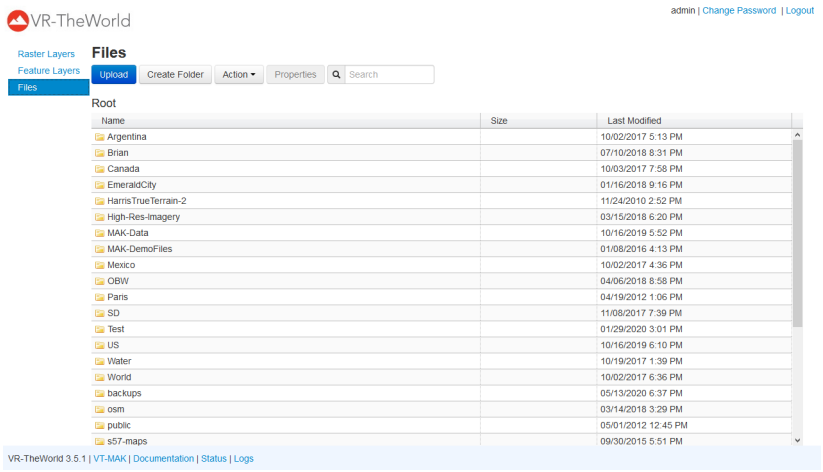

Figure 5-1. Manage Files tab

3. Click Create Folder. The Create Folder dialog box opens.
4. Type a name for the new folder.
5. Click OK. The folder is added to the files list.

5.3. Uploading Files

You can upload individual files and compressed files. If you upload a *.zip*, *.tar*, or *.tar.gz* file, VR-TheWorld Server uncompresses it.

To upload a file:

1. Log in as administrator.
2. Select the Files page.
3. Select the folder into which you want to upload a file.
4. Click Upload. A file selection dialog box opens.
5. Select the files you want to upload. (You can select multiple files using standard file selection methods.)
6. Click Open. VR-TheWorld Server provides feedback about the progress of the upload process.

5.4. Downloading Files

You can download files from the server to a local computer.

To download a file:

1. Log in as administrator.
2. Select the Files page.
3. Select the file you want to download.
4. Click **Action** → **Download**. A file open dialog box opens.

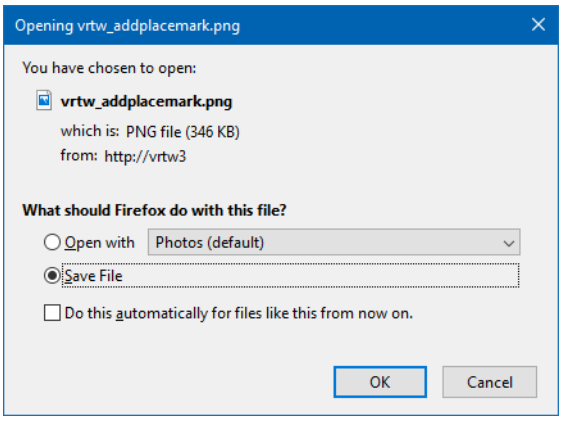

Figure 5-2. Download file

5. Select the Save File option.
6. Click OK. If your system is configured to save files to a default directory, the file is downloaded to that directory. Otherwise, specify a directory and file name for the file.

5.5. Viewing File Properties

VR-TheWorld Server can display information about the files in the database, such as the filename, pathname, type, size, and so on.

To display information about a file:

1. Select the Files page.
2. Select the file for which you want to view information.
3. Click the Properties button. File properties are displayed.

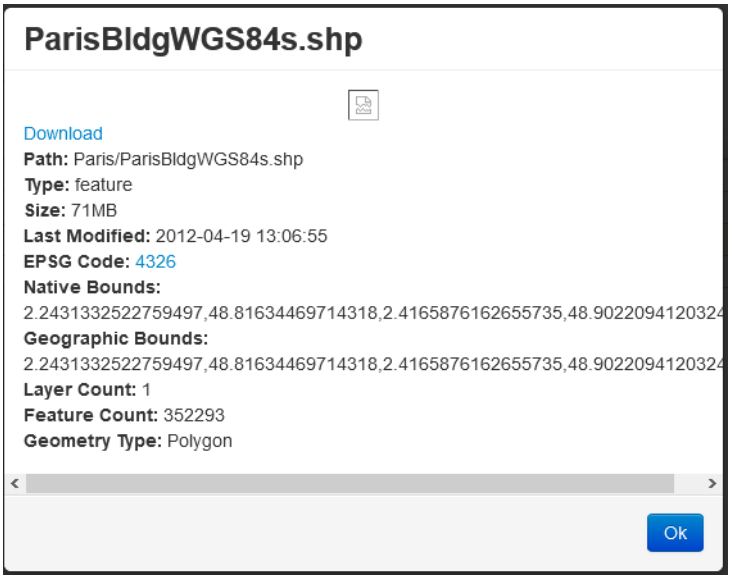

Figure 5-3. File properties

5.6. Deleting Files

To delete a file:

1. Log in as administrator.
2. Select the Files page.
3. Select the file or folder that you want to delete.
4. Click **Action** → **Delete**.
5. Confirm the request to delete the file.

5.7. Renaming Files

To rename a file:

1. Log in as administrator.
2. Select the Files page.
3. Select the file you want to rename.
4. Click **Action** → **Rename**. The Rename dialog box opens.
5. Type a new name for the file.
6. Click OK.

6. Performance Considerations

This chapter describes ways to improve performance for VR-TheWorld Server.

6.1. Maximizing Performance

In most cases, VR-TheWorld Server performs well out-of-the-box. However, performance will be affected by network performance and the configuration of the application that is streaming the terrain. The issues discussed in following sections may help you maximize performance.

6.1.1. Tile Size

The tile size parameter on imagery and elevation layers controls the pixel size of the image VR-TheWorld creates during tiling. The number is used both for the length and the width of the tile, so if the parameter is 256, the tile will be 256x256 pixels. VR-TheWorld can use any number in this field, but if the end application is to be an osgEarth based application, such as VR-Vantage, or any other 3D application like Google Earth, it is important that the number be a power of 2. This is because the tiles are used as textures in the graphics card. Imagery tile size is recommended to be 256. Elevation layer tile size is recommended to be 32. In the case of elevation, this controls how many points end up in the 3D terrain patch that is created from the tile. Increasing the number beyond 32 requires the client to have very powerful graphics hardware.

6.1.2. Pre-Tile Layers

If a layer is not tiled, VR-TheWorld generates tiles on the fly and stores them as they are required. This is useful for quickly testing layers and interacting with the data. However this generating process can cause undesirable slow spots when the client application is moving around the data. If all the tiles are generated, the server simply needs to look up the tile and return instead of having to render it.

At times it may not be feasible to pre-generate all the tiles. Tiling tasks can take a long time depending on the detail level and the area covered. In this case, it is often best to generate the lowest levels first. The hardest tiles to generate are the overview tiles. These tiles tend to have the most source files required for every tile. So if your data extends to level 18, and if you create a tiling task that does levels 0-12 instead of automatically tiling all levels, you will drastically reduce the length of time the task takes. Every level is roughly 4 times the size of the previous level in terms of numbers of tiles.

This approach means clients will only generate tiles once they zoom in to areas, which typically represent a low number of tiles. While the tiling operation is running, the client can usually still show the lower resolution tiles that are already generated until the higher resolution is available.

6.1.3. Composite Layers

Each layer in a map represents a new connection to VR-TheWorld by the client and tiles that must be downloaded for any given area. The client then draws each layer onto the scene. Composite layers allow you to combine layers on the server and have the server perform the task of rendering every layer to generate the final image. The server then caches the rendered tiles like any other layer. This allows the client to make a single connection to the server and only render one tile over a basemap layer instead of rendering multiple layers and downloading multiple tiles. It is not recommended to combine the base global layers such as Base Imagery into composite layers since the base layers are very large and this may ultimately cause the base layers to be copied to the composite layer. A typical map would be expected to have a base layer and one or two overlay layers for maximum performance.

6.1.4. Files Per Layer

VR-TheWorld can have difficulty when there are more than 1000 source files in a layer. This is due to the tile rendering process and how much memory can be consumed by large numbers of highly compressed source files. If you want to have layers with more than 1000 source files then it is recommended that you split the layer into multiple smaller layers and use a composite layer to pull the split layers together.

6.1.5. Client-Side Caching

If you use VR-Vantage, it caches as much of the VR-TheWorld terrain as it can, which eliminates the need to re-download tiles for areas that have recently been viewed. This is the most dramatic improvement in performance that can be achieved. osgEarth applications can add caching to their earth file by adding a **`cache`** block to the **`options`** block.

6.1.6. Feature Attributes

When using features, it is best to upload feature data sets that match the client tasks as closely as possible. When a client connects to VR-TheWorld for features, it downloads all the feature attributes associated with the feature. If unused attributes are removed from the feature data set before uploading to VR-TheWorld then they will not be downloaded by the clients. This in turn makes the size of the feature tiles smaller and quicker to download.

6.1.7. Controlling where Paging is Handled

If you include a **<level>** block in the **<layout>** element of an earth file, the entire dataset is downloaded from the server at once and all the paging is done locally, ignoring any pre-tiling done on the server. Therefore, do not include a **<level>** block if you have a large data set. The layout block should look like:

```
<layout>
  <tile_size_factor>5</tile_size_factor>
</layout>
```

6.2. OSG and osgEarth Environment Variables

You can improve performance for some terrains by configuring the following environment variables:

- OSG_MAX_PAGEDLOD. OSG_MAX_PAGEDLOD specifies the target maximum number of paged LODs to maintain. Default: 200. Set it to a lower value if you need to reduce memory consumption when using paged terrains.
- GDAL_CACHEMAX. GDAL_CACHEMAX specifies the maximum cache size for streaming terrain. The default value is 200 MB, which is often adequate. However, if you are using a highly detailed terrain, increasing the cache size to a larger value, such as 2000, can significantly improve performance.
- You can configure caching in the <cache> element in the earth file or in the OSGEARTH_CACHE_PATH environment variable.

6.3. Viewing the Web Log Analyzer

VR-TheWorldServer incorporates a weblog analyzer (Figure 6-1). It provides many types of statistics displays that can help you understand use of the server. If you have any questions about it, please contact support@mak.com.

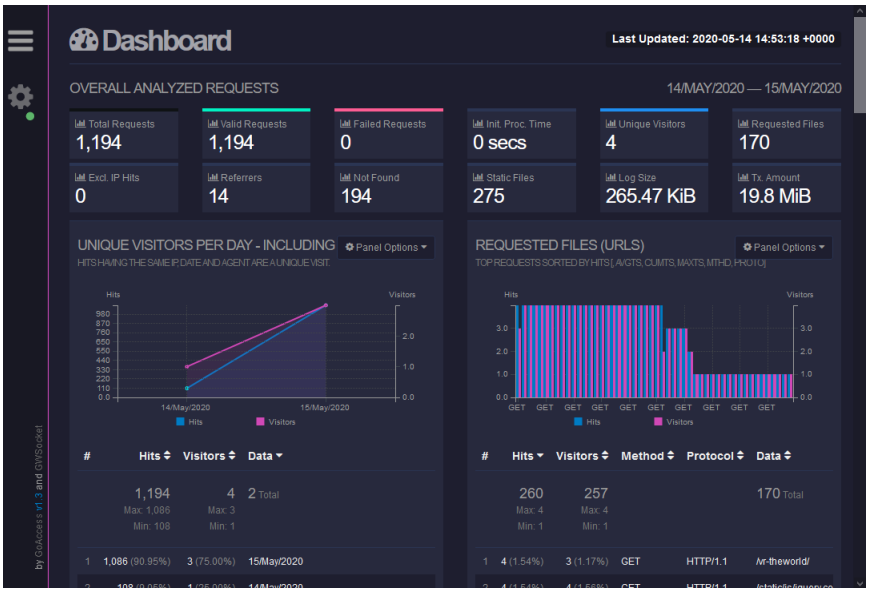

Figure 6-1. Web log

To view the web log analyzer:

1. In the VR-TheWorldServer window, on the status bar, click Status. A login screen opens.
2. Enter your administrator username and password.
3. Click OK. The web log analyzer opens in a separate window.

6.4. Viewing Log Files

VR-TheWorldServer maintains several log files. You can view them in your browser (Figure 6-2).

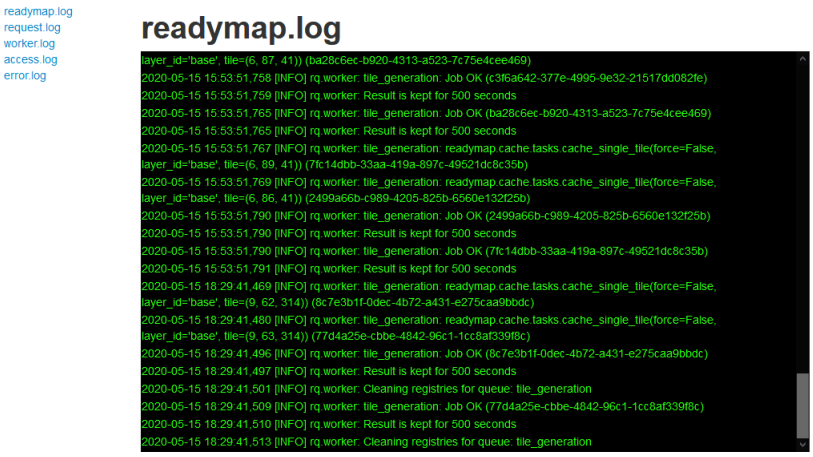

Figure 6-2. Log files

To view the log files:

1. On the status bar, click Logs. A new window opens. It has a list of the logs available.
2. Click the name of the log that you want to view.

A. Terrain Sources

This appendix lists the source for the data used by VR-TheWorld Server.

A.1. Terrain Sources

Table A-1 lists the terrains installed by VR-TheWorld Server and details about them. Table A-2 lists the source material that make up the MAK Combined 30m+ Elevation Layer.

Table A-1: VR-TheWorld Server data sources (Sheet 1 of 6)

Layer		Details
Base imagery	Source	Pelican Mapping
	Website	
	Comments	Base imagery layer is made by Pelican Mapping combining LandSat 7 15m imagery and BlueMarble ocean imagery.
	Layer type	Tile only.
Base Imagery Boston Inset	Source	Pelican Mapping
	Website	http://www.mass.gov/mgis/massgis.htm
	Comments	U.S. Geological Survey (USGS) data obtained from Massachusetts Geographic Information System (MassGIS).
	Layer type	Tile only.
Base Imagery DC inset	Source	Pelican Mapping
	Website	http://data.dc.gov/
	Comments	District of Columbia GIS Program 2008 Ortho-photo.
	Layer type	Tile only.
Base Imagery Afghanistan inset	Source	Pelican Mapping
	Website	http://mapserver.cmf.nrl.navy.mil/
	Comments	Sourced from Project Rampant Lion 1
	Layer type	Tile only.
Base elevation	Source	Pelican Mapping
	Website	http://srtm.csi.cgiar.org/ http://topex.ucsd.edu/WWW_html/srtm30_plus.html
	Comments	Sourced from CGIAR. The 90m elevation posts are ultimately from the Shuttle Radar Topographic Mission. Bathymetry comes from the Scripps Institute of Oceanography SRTM30PLUS.
	Layer type	Tile only.

Table A-1: VR-TheWorld Server data sources (Sheet 2 of 6)

Layer		Details
Amherst	Source	Amherst, Massachusetts, USA
	Website	http://www.amher-stma.gov/index.aspx?nid=1432
	Comments	
	Layer type	Local.
WAC,SEC, TAC and combined Aeronautical Charts layers	Source	U.S. Federal Aviation Administration (FAA)
	Website	http://aeronav.faa.gov/index.asp?xml=aerona v/applications
	Comments	Purchased from Mypilotstore.com, then downloaded more from the FAA.
	Layer type	Local.
Chicago	Source	USGS
	Website	http://seamless.usgs.gov/hro.php
	Comments	Seamless data warehouse: IL_CookCounty_0.5ft_Color_May_2008_01, IL_CookCounty_0.5ft_Color_May_2008_02, IL_CookCounty_0.5ft_Color_May_2008_03, IL_DupageCounty_0.5ft_Color_May_2008
	Layer type	WMS, locally tiled.
Delaware	Source	USGS
	Website	http://seamless.usgs.gov/hro.php
	Comments	Seamless data warehouse: DE_State_0.25m_-Color_Mar_2007
	Layer type	WMS, locally tiled.
Harris globe - White Sands, Holloman AFB	Source	Harris Corporation
	Website	
	Comments	Demonstration layers.
	Layer type	Local.
Hawaii	Source	Harris Corporation
	Website	
	Comments	Purchased from Harris. 15m Hawaiian Islands.
	Layer type	Local.

Table A-1: VR-TheWorld Server data sources (Sheet 3 of 6)

Layer		Details
HI RNC	Source	U.S. National Oceanic and Atmospheric Administration (NOAA)
	Website	http://www.charts.noaa.gov/RNCs/RNCs.shtml
	Comments	National Ocean and Atmosphere Administration Office of Coast Survey.
	Layer type	Local.
Honolulu Water imagery	Source	Harris Corporation
	Website	
	Comments	Purchased from Harris. Blending between 1ft and 15m coast line for south Oahu.
	Layer type	Local.
Kandahar	Source	MAK
	Website	www.mak.com (Source data is not available on the web site.)
	Comments	MAK's hand modeled VR-Village inset into the Project Lion sourced Kandahar image.
	Layer type	Local.
Long Island	Source	USGS
	Website	http://seamless.usgs.gov/hro.php
	Comments	Seamless data warehouse: NY_StateLongIsland_0.5ft_Color_Apr_2007
	Layer type	WMS, locally tiled.
Mass15 and 30cm	Source	Massachusetts Geographic Information System (MassGIS)
	Website	http://www.mass.gov/mgis/massgis.htm
	Comments	Work in progress.
	Layer type	Local.
miami	Source	USGS
	Website	http://seamless.usgs.gov/hro.php
	Comments	Seamless data warehouse: FL_DadeCounty_1.0ft_Color_Jan_2009
	Layer type	WMS, locally tiled.

Table A-1: VR-TheWorld Server data sources (Sheet 4 of 6)

Layer		Details
NAIP	Source	U.S. Department of Agriculture (USDA)
	Website	http://seamless.usgs.gov/naip.php
	Comments	Seamless data warehouse.
	Layer type	WMS, partially locally tiled.
nexrad	Source	Iowa State University
	Website	http://mesonet.agron.iastate.edu/docs/nexrad_composites/
	Comments	Not tiled, because map updates every 45 minutes.
	Layer type	WMS.
NJ	Source	USGS
	Website	http://njgin.state.nj.us/ortho2007/
	Comments	Originally USGS data downloaded through seamless, but it moved to the New Jersey Geographic Information Network (NJGIN) site.
	Layer type	Local.
NYC	Source	USGS
	Website	http://seamless.usgs.gov/hro.php
	Comments	Seamless data warehouse: NY_StateLongIsland_2.0ft_Color_Apr_2008
	Layer type	WMS, locally tiled.
Oahu	Source	USGS
	Website	http://hawaii.wr.usgs.gov/oahu/index.html
	Comments	
	Layer type	Local.
Oahu DRG	Source	USGS
	Website	http://hawaii.wr.usgs.gov/oahu/index.html
	Comments	
	Layer type	Local.
Oahu 10m DEM	Source	USGS
	Website	http://hawaii.wr.usgs.gov/oahu/index.html
	Comments	
	Layer type	Local.

Table A-1: VR-TheWorld Server data sources (Sheet 5 of 6)

Layer		Details
Ocean Route Charts	Source	FAA
	Website	http://aeronav.faa.gov/index.asp?xml=aeronav/applications
	Comments	
	Layer type	Local.
Orlando	Source	USGS
	Website	http://seamless.usgs.gov/hro.php
	Comments	Seamless data warehouse: Orange and Seminola Counties Apr 2008 1f
	Layer type	WMS, locally tiled.
Ridge Radar	Source	NOAA NWS
	Website	http://www.nws.noaa.gov/gis/otherpage.htm
	Comments	National weather service, live updating, not tiled.
	Layer type	WMS
San Diego	Source	USGS
	Website	
	Comments	Probably USGS.
	Layer type	Local.
Spot Map	Source	SpotImage.
	Website	
	Comments	Example layer of SpotImage.
	Layer type	WMS
US Canada Border	Source	USGS
	Website	http://seamless.usgs.gov/hro.php
	Comments	Seamless data warehouse: high resolution border imagery.
	Layer type	WMS, partially tiled.
Boston Buildings	Source	Pelican Mapping
	Website	
	Comments	Probably from MassGIS, but no longer available on that site.
	Layer type	

Table A-1: VR-TheWorld Server data sources (Sheet 6 of 6)

Layer		Details
DC buildings	Source	District of Columbia Geographic Information System (DC GIS)
	Website	http://data.dc.gov/
	Comments	District of Columbia GIS Program.
	Layer type	
Oahu Lights	Source	MAK
	Website	www.mak.com (Source data is not available on the web site.)
	Comments	
	Layer type	
Oahu Buildings	Source	Honolulu Land Information System (HoLIS)
	Website	http://gis.hicentral.com/data.html
	Comments	Airport cropped out of data.
	Layer type	
Oahu Vegetation	Source	MAK
	Website	www.mak.com (Source data is not available on the web site.)
	Comments	
	Layer type	
Structure NGA	Source	HoLIS
	Website	http://gis.hicentral.com/data.html
	Comments	Original Oahu buildings.
	Layer type	
Waiau Infrastructure	Source	MAK
	Website	www.mak.com (Source data is not available on the web site.)
	Comments	
	Layer type	

Table A-2: Sources for the MAK Combined 30m+ Elevation Layer

Data	Coverage	Description
SRTM15_Plus	Global	Global 15 arcsecond (500m) elevation plus bathymetry. UC San Diego: http://topex.ucsd.edu/WWW_html/srtm30_plus.html
SRTM1	60N to 56S worldwide	1 arc second (30m) resolution elevation. Date: February 2000. NASA: https://lpdaac.usgs.gov/dataset_discovery/measures/measures_products_table/srtmgl1_v003 Geoprocessing: Converted from Int16 hgt format to Float32 TIF to facilitate merging in the EU-DEM Values = 0 removed

Table A-2: Sources for the MAK Combined 30m+ Elevation Layer

Data	Coverage	Description
EU-DEM	Albania, Austria, Belgium, Bosnia and Herzegovina, Bulgaria, Croatia, Cyprus, Czechia, Denmark,Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Kosovo (UNSCR 1244/99),Latvia, Liechtenstein, Lithuania, Luxembourg, Macedonia (FYR), Malta, Montenegro, Netherlands,Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, United Kingdom	1 arc second (30m) resolution elevation. Date: 2000. Source: http://www.eea.europa.eu/data-and-maps/data/eu-dem Geoprocessing: Projected to WGS84

Table A-2: Sources for the MAK Combined 30m+ Elevation Layer

Data	Coverage	Description
CDEM v3	Canada	0.75 arc second (22m) resolution elevation. Date: 2012. Source: http://geogratis.gc.ca/api/en/nrcan-rncan/ess-sst/c40acfba-c722-4be1-862e-146b80be738e.html Geoprocessing: Water removed (0 elevation), Great Lakes water removed (various elevations).
Modelo Digital de Elevaciones de la Argentina	Argentina	30m resolution elevation. Date: 2000. Source: http://www.ign.gob.ar/NuestrasActividades/Geodesia/ModeloDigitalElevaciones Geoprocessing: Water removed (0 elevation), Files merged for performance.
Continuo de Elevaciones Mexicano 3.0	Continental Mexico	15m resolution elevation. Date: 2012. Source: http://www.inegi.org.mx/geo/contenidos/datosrelieve/continental/continuoelevaciones.aspx Geoprocessing: File merged for faster processing.
Coastal Relief Model	Coastline of lower 48 states (United States), Hawaii, and Puerto Rico	3 arc second (90m) US coastal elevation/bathymetric model. Date: Varies ~2005 Source: NOAA. https://www.ngdc.noaa.gov/mgg/coastal/crm.html Geoprocessing: 1 arc second southern California, elevation > 0 removed.
Tsunami Inundation	West Coast of US and some East Coast locations, plus some Alaska coastline, Puerto Rico, Bermuda, Virgin Islands, Guam, Midway	10m coastal continuous elevation and bathymetry (lower resolutions for Alaska and some islands). Date: Varies. Source: https://www.ngdc.noaa.gov/mgg/inundation/tsunami/inundation.html Geoprocessing: Some files merged with 10m 3DEP.

Table A-2: Sources for the MAK Combined 30m+ Elevation Layer

Data	Coverage	Description
Estuarine Bathymetry	Only used east Coast US in areas not covered by Tsunami Inundation DEMS	30m bathymetry of selected US estuarine areas. Date: Varies. Source: http://estuarinebathymetry.noaa.gov/finddata.html Geoprocessing: Values > 0 removed.
Great Lakes Bathymetry	Great Lakes (US/Canada	3 arc second bathymetry of the Great Lakes. Source: https://www.ngdc.noaa.gov/mgg/greatlakes/greatlakes.html. Geoprocessing: Sourced in lake level datum, used Wikipedia to determine lake level for each lake and then converted it to reference the ellipsoid. Lake bathymetry merged into SRTM 30m.
3DEP 10m	Washington, Oregon, California and Nevada (United States)	10m data for US. Source: 3DEP (3D Elevation Program) is the elevation component of the USGS National Map, replacing the NED (National Elevation Dataset). https://viewer.nationalmap.gov/basic/?basemap=b1&category=ned,nedsrc&title=3DEP%20View Date: Varies. Geoprocessing: Areas that cover water are removed to allow for bathymetry. Many files are merged for faster processing. Washington files are merged with the Tsunami Elevation dataset (10m) and the Puget Sound DEM for continuous elevation and bathymetry. Oregon and California are also merged with the Tsunami Elevation Dataset.
3DEP 1m	San Diego County, greater New York City Area, Boston (US)	1m data for San Diego and several other cities. Source: 3DEP (3D Elevation Program) is the elevation component of the USGS National Map, replacing the NED (National Elevation Dataset). https://viewer.nationalmap.gov/basic/?basemap=b1&category=ned,nedsrc&title=3DEP%20View Date: Varies. Geoprocessing: Areas that cover water are removed to allow for bathymetry. Many files are merged for faster processing.

Table A-2: Sources for the MAK Combined 30m+ Elevation Layer

Data	Coverage	Description
Catalina island	Catalina island	5 ft (1.7m) for Catalina island, California, USA. Source: Los Angeles County. https://egis3.lacounty.gov/data-portal/2010/02/19/2006-5-foot-1-7m-digital-elevation-model-dem/ Geoprocessing:. Removed values less than zero, merged in bathymetry from tsunami inundation, subtracted 1.5m from all values from 0-2 to remove an anomaly and merge the bathymetry into the land data. Note: at some point may use this source dataset for the rest of LA county.
Puget Sound Digital Elevation Model (PSDEM)	Puget Sound (Seattle/ Tacoma, US area)	Finlayson D.P. (2005) Combined bathymetry and topography of the Puget Lowland, Washington State, US. Source: University of Washington School of Oceanography. https://www.ocean.washington.edu/data/puget-sound/psdem2005.html Geoprocessing: Reprojected to WGS84. Bathymetry Merged into the Washington 10m dem (see 3DEP)
MAK's 1 arc second (30m) dataset	World	A combination of all of the 30m data sources above (SRTM1, EU-DEM with 1 arc second bathymetry sources, but without combining non-30m sources). This dataset exists (created outside of VR-TheWorld) because VR-TheWorld doesn't allow us to specify an order of precedence for layers of the same resolution. Therefore, all 30-meter sources needed to be combined, before being further combined with other-resolution sources. Geoprocessing: GDAL virtual file created out of the SRTM1 and the EUDEM (EUDEM taking precedence for its coverage). Virtual file then split into 100k x 100k pixel TIFF files with null data files removed. Overlaid with: ◆ Southern california 1 arc second coastal relief model ◆ Great lakes bathymetry ◆ Estuarine bathymetry

Index

E

F

G

H

I

L

M

N

O

P

R

S

T

U

V

W

X-Y-Z

VRW-3.9.6-1-201109

MAK TECHNOLOGIES 150 CAMBRIDGE PARK DRIVE, 3RD FLOOR, CAMBRIDGE, MA 02140 | 617.876.8085 | www.mak.com