# DRAFT

## Research in 2021 and 2022 at the Jungfernhof Concentration Camp: Riga, Latvia

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### Introduction and Background

This introduction and background, in part, were extracted from previous writings by Dr. Richard Freund. As we prepared for our first research project at the site in July 2021, Dr. Freund, as he regularly did, compiled a detailed historical overview of the location, from which our research could begin, using our expertise in geophysics, mapping and spatial analysis to write and/or rewrite the history of the Jungfernhof Concentration Camp. Some of what was compiled by Professor Freund is adapted from Gatis Pavils (2009).

In July 2021 and 2022, researchers from Duquesne University, the University of Wisconsin-Eau Claire, Christopher Newport University, and BGC Engineering, Inc., with assistance from the Museum of the Jews in Latvia, and the Lock(er) of Memory Project, completed research in the vicinity of the Jungferhof Concentration Camp, in Riga Latvia (see figure 1). The directors of the project were Dr. Richard Freund, Dr. Harry Jol and Dr. Philip Reeder, and the research team also consisted of geophysicists from BGC Engineering in Calgary, Alberta, Canada (Paul Bauman and Colin Miazga). Student participants for 2021 included, from Christopher Newport University: Mikaela Martinez-Dettinger and Kayla Singleton; from the University of British Columbia: Connor Jol; and from the University College of London: Patrick Wiley. The roster of students for 2022 included, from the University of Wisconsin-Eau Claire: Delia Ihinger, Tristan Wirkus, Bri Jol, Taylor Phillips, and Michael Barrow; and from Christopher Newport University: Mikaela Martinez-Dettinger.

### Brief History of the Site Prior to World War II:

To understand and interpret the context of the Jungfernhof Concentration Camp using geophysics, mapping and spatial analysis techniques, it is important to know the history of the area. Today only a few remnants of the last major usage of the area, the concentration camp, remain. The site of the camp is located 1 ½ kilometers south of the Šķirotava freight (rail) yard, and about 12 kilometers from the Riga City Center, on the Daugava River (see figure 1). The nuns of the Cistercian monastery of the Riga Jacob Church settled this area just north of the Daugava River in 1259. At that time the area was only occupied by the nuns, and a few peasant farmers. From that time, up until the 17th century, the area was named Blumendahl. Eventually, the area began to be called Jumpravmuiza, after the nuns living there (jumprava in Latvian means maiden). In order to distinguish it from another location called Jumpravmuiza, which was located upstream along the Daugava River, this area came to be called Little Jumpravmuiza.  In 1627 the Swedish King Gustav II Adolf awarded the manor house that was built in the area, and the surrounding lands to the master of the Riga Mint, Martin Wulf, who at that time became the landlord and known as Wulfenschield.  In 1636 Wulfenschield sold the manor to the municipality of Riga.  In 1700 the Little Jumpravmuiza area was traversed by Russian and Saxon troops under the command of Peter I.  In this period of the early 18th century, the owner of the manor became Paul Brockhusen and family, who allowed the area to fall into disrepair, and in 1752 the manor reverted once again back to ownership by the Riga municipality.  In 1794 it was documented that 3,357 people lived in the manor area (Pavils, 2009).

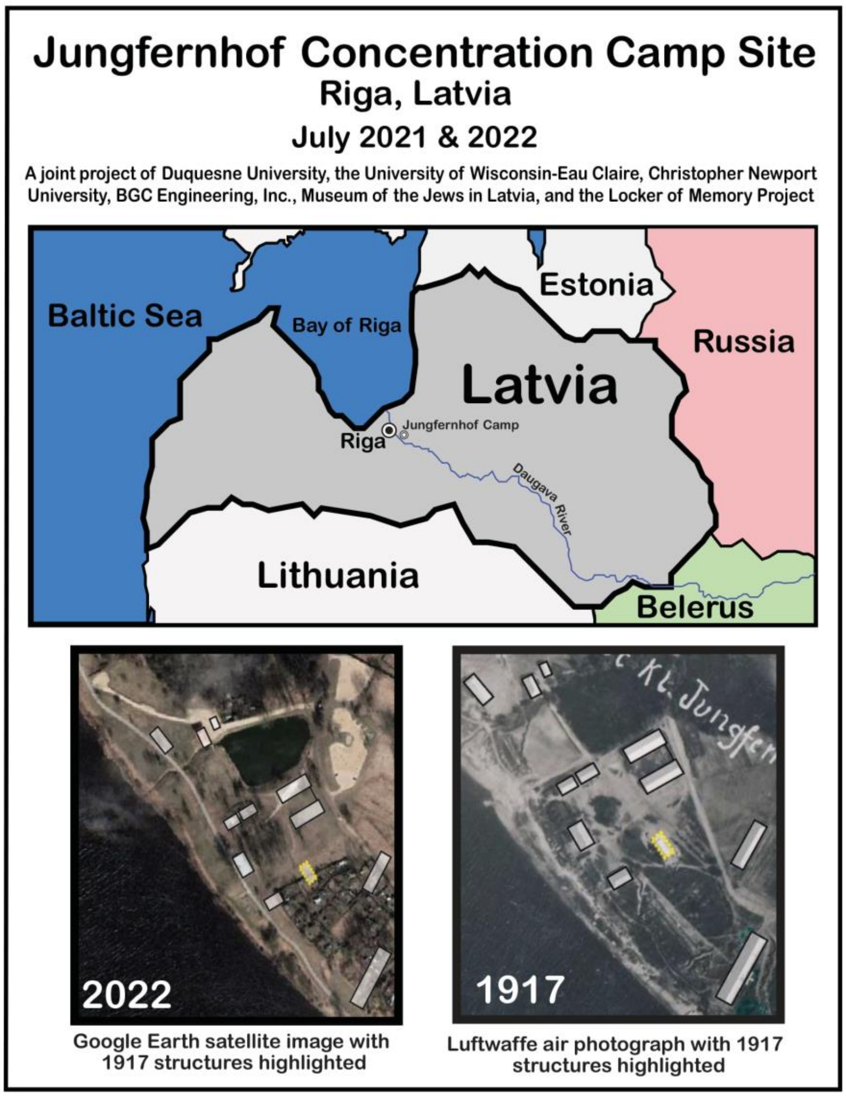


Figure 1 – Location of the Jungfernhof Concentration Camp near Riga, Latvia, with the layout of 1917 camp structures put onto a 2022 satellite image, and the 1917 air photo.

In 1877, the Riga City Forest and Manor Office leased the manor to Johann Ratfeld, with the lease agreement indicting that 16 buildings existed in the territory of the manor. In 1915 the manor was abandoned, and then is 1916/1917 a supply facility was set up by the Russians at the site. In 1917 German troops established a farm, and in 1919 the area was handed over to the Riga Polytechnic School to establish an agricultural training farm. In 1920, the Latvian youth union Katlakalns installed its cultural center in the manor, and from 1925 to 1940 the area was rented by Genius Štobbe.

**Parallel History of the Holocaust by Bullets and the Jungfernhof Concentration Camp:**

When asked when the Holocaust by Bullets began, it is usually answered that it was before the Wannsee Conference in Berlin in January 1942. At this conference the final solution of the Jewish question was determined to be the systematic death of Jews by coordinated actions. There were steps that the Nazis went through to ensure that the early killing of the Jews would be part of a coordinated propaganda effort to portray the Jews in negative stereotypes. The Jungfernhof Concentration Camp is a unique and significant example of how the Holocaust by Bullets was begun in many different ways.

In the summer of 1941, the Molotov–Ribbentrop non-aggression pact between Nazi Germany and the Soviets was terminated June 22, 1941) when Germany launched Operation Barbarossa and invaded the Soviet Union (Schattenberg, 2009). At this point of change and confusion, the Nazis realized that there was an opportunity to rid Nazi Germany of Jews that remained in both Germany and Austria. Instead of killing those Jews in Germany and Austria, it was decided to ship them by train to the farthest reaches of the new Nazi territories. Nazi authorities sent some of the most prominent Jewish-German religious and cultural leaders to these farthest reaches. It is speculated that these Jews were going to be used later for bartering for key resources, or that it would have been a propaganda debacle if they had been left in Germany and Austria to be killed.

The improvised concentration camp Jungferhof, in operation from December 1941 through March 1942, was set up at the Mazjumprava Manor (Little Jumpravmuiza). The camp served as overflow housing for Jews from Germany and Austria, who had originally been intended to stay in Minsk, but who were moved to Riga instead. The Riga Ghetto was overcrowded and could not accommodate these deported Jews, so when the first transport train with 1,053 Berlin Jews arrived at the Šķirotava Railway Station on November 30, 1941, all persons on board were murdered that same day. The sixth transport arrived in Riga on December 10, 1941, with Jews from Cologne, Germany. These Jews were housed in the newly "freed up" Riga Ghetto (see figure 2), where space was now available because Jews from the ghetto had recently been killed at Rumbula and in the Bikernieku Forest (Galbreath, 2007).

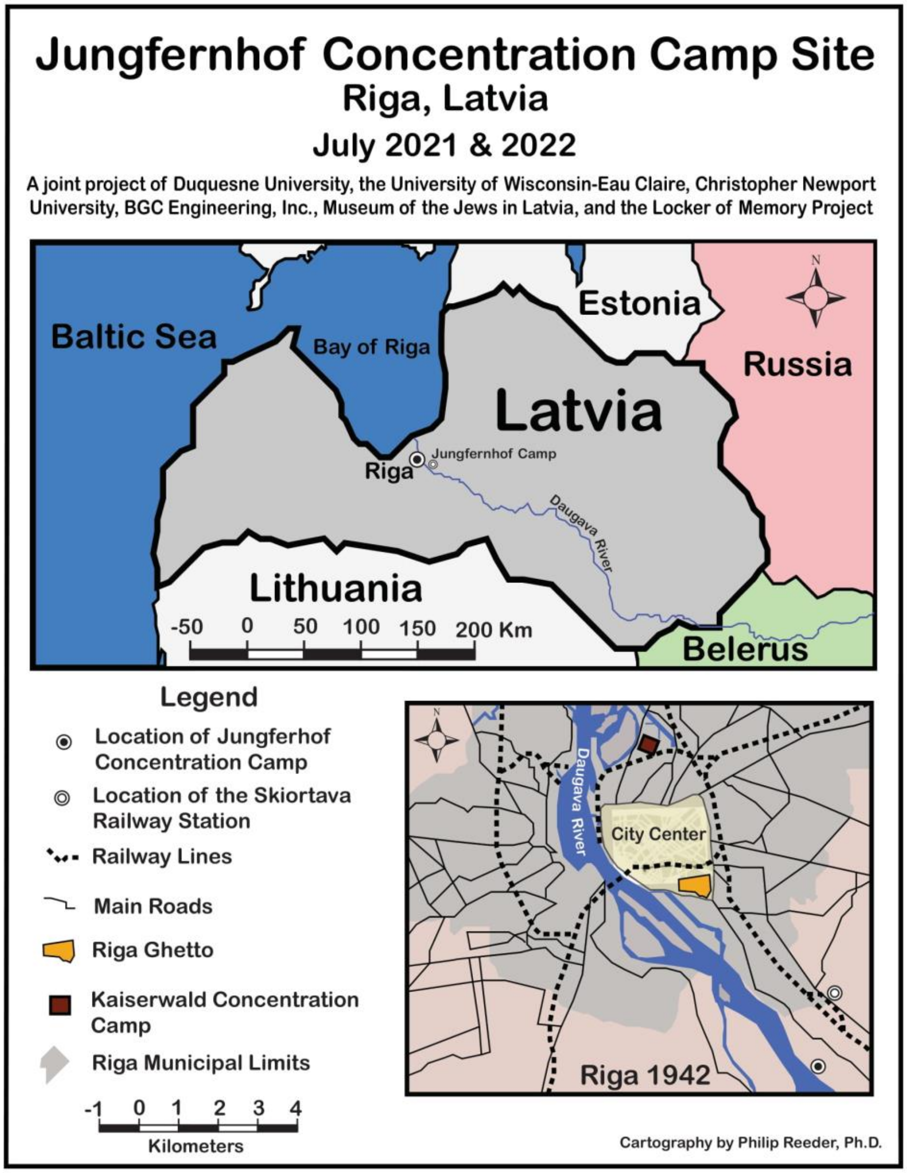


Figure 2 – The location of the Jungfernhof Concentration Camp in modern-day Riga, Latvia (upper panel), with its location to Riga in 1942.

In December 1941, a total of 3,984 German/Austrian Jews were deported from Nuremburg, Vienna, Hamburg and Stuttgart, and because space was again limited in the Riga Ghetto, they were transported to Jungfernhof. The former Little Jumpravmuiza estate, was 200 hectares in size, and located on the property were a warehouse (s), three large barns, five small barracks and various cattle sheds (Pavils, 2009). Most structures were dilapidated, and not suitable for habitation. Based on published survivor testimony, 600 to 800 prisoners died or were killed in winter 1941-1942, and buried in a mass grave within the confines of the makeshift camp.

## Research Design

This project's main objective is to add information to the existing base of knowledge about the death, murder and burial of Jews at Jungfernhof in the winter of 1941/1942. Very little is known about the precise details of what happened at the camp. Some survivor testimony has been collected by Dr. Karen Frostig, the Director of the Lock(er) of Memory Project. Interviews with survivors Herbert Mai, Fred Zeilberger, and Peter Stern (https://www.lockerofmemory.com/interviews-with-survivors) are posted on the Lock(er) of Memory website. Over the 80 years since the camp was in operation, and Jews died or were killed there, no direct, onsite evidence has been gathered about what happened at Jungfernhof, so that these occurrences can be added to the historical record of the Holocaust in Latvia, and beyond. The research conducted at the site in summer 2021 and 2022 was intended to answer the following research questions:

1. Can target areas for the completion of Ground Penetrating Radar (GPR) data collection be established based on comparisons between a 1917 air photo of the Jungfernhof area, recent Google Earth satellite images of the area, and onsite reconnaissance?
2. Once the location(s) of the target area(s) is/are established, will GPR analysis of grids set up to coincide with the target area(s) indicate the presence of single or multiple data anomalies?
3. Can Electrical Resistivity Tomography (ERT) transects be established to better define subsurface features/anomalies at the site?
4. If found, will the GPR and ERT anomalies both indicate features at the same location?
5. Will GPR and ERT anomalies coincide with features from the 1917 air photograph, and/or the 1942 or 1947 maps?
6. Will the hand-held lidar device "Geo-Slam" indicate the presence of subtle topographic variations that can be interpreted as an indicator of subsurface features?
7. Will multispectral images collected using a drone indicate the presence of features on the land surface that coincide with features indicated by the "GeoSlam?"
8. If present, will these features coincide with ERT and/or GPR anomalies?
9. Will the comparison of the 1917 air photograph, and maps of the site from 1942 and 1947 indicate similarities and/or differences in the presence of buildings at the site?
10. Will the data collected in summer 2021 and 2022 provide the impetus for the completion of additional research in the area in summer 2023, to further clarify the existence and characteristics of features detected in the 2021 and 2022 data sets?

The data collected for this project will be used to provide answers for the ten stated research questions. The specific data related to effectively answering each question are presented in the Results and Discussion section of this report, and they are summarized as well in the summary, review and conclusions section.

## Methodology

Multiple methods were employed to collect, analyze and assess data related to this project. An air photograph of the site in 1917 (Figure 3) was obtained from Karen Frostig. Satellite images for multiple years from 1985 to 2022 were obtained using online features of Google Earth. Maps for the area were obtained from the website: https://vesture.dodies.lv/. The air photo, map and satellite images were compared visually, and by creating overlays using Adobe Illustrator software.

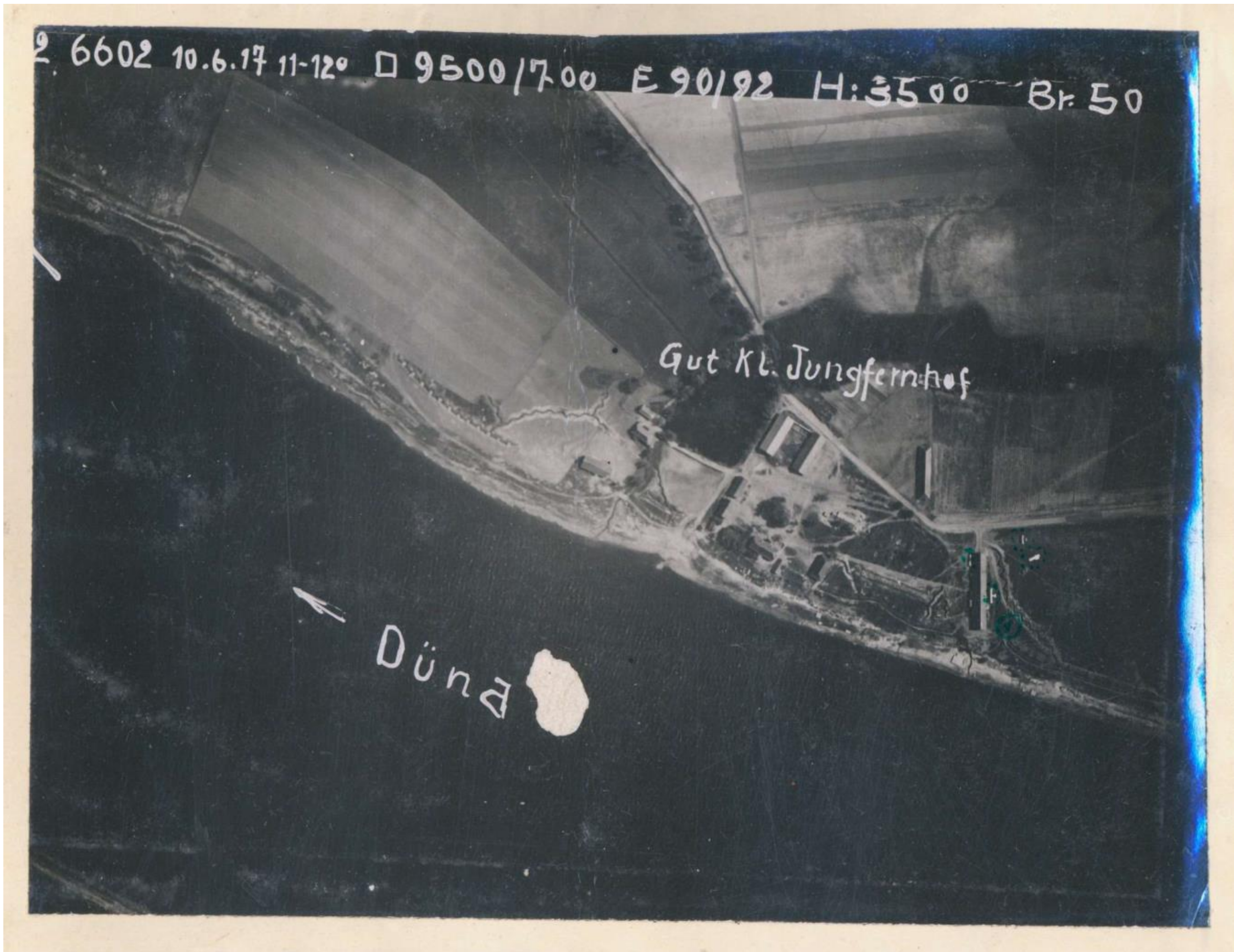


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Figure 3 – 1917 German air photograph of the Jungfernhof Camp area.

The non-invasive geophysical technique Ground Penetrating Radar (GPR) was used to collect data about the subsurface in the vicinity of the target area, which is depicted in multiple figures in this report. Three grids were established in the target area (two in

2021 and one in 2022), with Grid 1 (2022) measuring 15 x 10 meters, with the main axis of the grid running in a north-northwest to south-southeast direction (see figure 6). Grid 2 (2021) measured 7 x 20 meters, with the main axis of the grid running in a north-northeast to south-southwest direction (see figure 6). Grid 3, from summer 2022, measured 15 x 40 meters with the main axis of the grid running in a north-northwest to south-southeast direction (see Figure 19). The GPR grids were established in these locations, and at these orientations to maximize the possibility of intercepting subsurface anomalies. The two grids from 2021were placed in locations that deliberately intersected two ERT transect lines. These lines were placed at locations, based upon anecdotal evidence provided by Iyla Lensky, the Director of the Jews in Latvia Museum, to coincide with possible features associated with the Jungfernhof Camp. GPR grid 3, from summer 2022, was place at a location that indicated, based upon 2021 ERT data, the possible location of a feature(s) from the Jungfernhof Camp.

The GPR technique used in this study is based on the propagation and reflection of pulsed high frequency electromagnetic (EM) energy. This field technique provides near surface, high resolution, near continuous profiles of archaeological sites. GPR has become a popular method for investigation of the shallow subsurface features because of the above properties, and the availability of portable and robust, digital radar systems. Publications resulting from past investigations by the researchers involved in this project, as well as others, have shown that GPR is a valuable, efficient, and effective research methodology (Jol, 1995; Jol, 2009; Jol and Bristow, 2003; Jol and Smith, 1991). The GPR acquisition system Sensors and Software pulseEKKO™ was used for this project. The GPR profiles were collected with a 500-Megahertz (MHz) antennae which provided images of the subsurface. The antennae separation for the project was 0.5 m, and to provide good horizontal resolution, a step size was 0.02 m (Jol, 1995; Jol and Bristow, 2003). To aid in data collection time, a carrier transport system was employed (see Figure 4). Each trace was vertically stacked with an appropriate sampling rate. The digital profiles were downloaded, saved to an external hard drive, processed, and plotted using pulseEKKO, GFP Edit and EKKO_Project software packages. Basic processing included automatic gain control (AGC), signal saturation correction, trace stacking (horizontal averaging) and point stacking (running average), as well as other routines when necessary. Near surface velocity measurements were calculated. The profiles were corrected for topography using a Topcon Total Station, and/or a Topcon Laser Leveler. The application of radar stratigraphic analysis (distinct signature patterns) on the collected data provides the framework to investigate both lateral and vertical geometry and stratification of the archaeological features being assessed (Jol and Bristow, 2003; Jol and Smith, 1991).

Electrical Resistivity Tomography **(**ERT) is a technique for mapping the distribution of subsurface electrical resistivity (or its inverse, conductivity) in a cross-sectional format. Resistivity data was collected through a linear array of electrodes coupled to a direct current (DC) resistivity transmitter and receiver, and electronic switching relays. Two ERT lines were place in the study area in summer 2021 (see Figure 6). ERT line 1 was

139 meters in length and coincided with the location of GPR 2 (from 2021). ERT 2 was 100 meters in length and coincided with the location of GPR 1 (2021) and GPR 3 (2022) (see Figures 19 and 23). The spacing between electrodes along the ERT transect lines largely controls the horizontal and vertical resolution of the data (smaller spacing results in higher horizontal and vertical resolution). Similarly, the length of the array controls the depth of investigation (longer arrays yield greater investigation depths). Data collection is carried out in a sequential and automated fashion that takes advantage of all possible combinations of current injection and potential measurement electrodes. The data are downloaded to a computer for processing and analysis. The data are inverted (i.e. modelled) using a two-dimensional (2-D) finite difference or finite element inversion routine using the software package RES2D. The final product is a 2-D cross-section (known as a "true" geoelectric section) plotting resistivity (in Ohm-m), or conductivity (in milliSiemens per meters [mS/m]), versus depth.

Induced Polarity (IP) is a second electrical imaging survey that is collected simultaneously, and with the same equipment as the ERT survey. While resistivity surveys image the subsurface in terms of its unit volume resistance to the passage of electrical current, IP images the subsurface in terms of its chargeability, which is loosely analogous to the ability of the subsurface to store electrical charge. While resistivity measurements are made while current is being passed through the subsurface, no current is actively transmitted during an IP measurement. Chargeability is measured in milliseconds (msec). The chargeability measurement is representative of the area under the voltage curve which rapidly decays after current is turned off. A chargeability section can be inverted (i.e. modelled) from the acquired raw IP data. Generally, sand and silt will have zero chargeability; clay may have a very low but measurable chargeability of a few msec. Metal objects, where present, will have chargeability's of tens, hundreds, or thousands of msec, depending on the size, surface area, and depth of burial.

Unmanned Aerial Vehicle (UAV) Photogrammetry and Multispectral Aerial Photography was used as well at the Jungfernhof site (see Figure 5). Multispectral imagery and visible light photogrammetry (also called RGB or red, green, blue color model) were collected from a MicaSense Sequoia camera mounted on to a DJI Matrice 100 quadcopter UAV (also called a "drone"). The Sequoia records four discrete spectral bands of light (MicaSense 2016) including green, red, Red Edge, and near infrared (NIR). Conventional photographs are also captured with the RGB visible light imager. A higher quality visible light camera (a 12.0-megapixel DJI Zenmeuse X3) was also mounted on the Matrice 100 to improve the quality of the photogrammetry.

Reflected energy in the green spectral band (wavelengths of 530 nanometres [nm] to 570 nm) is closely correlated to leaf chlorophyll content. As such, the green band may provide information where vegetation is stressed due to, for instance, buried pavement or a shallowly buried wall limiting root growth. Or, the green band may indicate areas of unusually healthy vegetation due to, for instance, an old garden plot or trench which may be capturing more moisture and nutrients. The red spectral band (wavelengths of 640 to 680 nm) is strongly absorbed by vegetation. As such, red band energy is used in the vegetation indices (such as Normalized Difference Vegetation Index [NDVI]) to calculate vegetation stress, or to contrast vegetation with exposed soil. The Red Edge band (narrow band of wavelengths of 730 nm to 740 nm) bridges the spectrum for red to near infrared reflectance and is particularly sensitive to plant nutrient stress. Near Infrared wavelengths (770 nm to 810 nm) are sensitive to vegetation type and vegetation stress. NIR, along with red, is used in the commonly mapped vegetation health indicator NDVI. This index is simply calculated as:

NDVI = (NIR – RED)/ (NIR + Red)

Photogrammetry is the science of creating maps from photographs. All multispectral information was managed through the photogrammetry software Pix4D.

The visible light imagery was used to create a georeferenced orthophoto (i.e., a photographic base map) using Pix4D and Agisoft Photo Scan software platforms. The Matrice 100 was flown at an altitude of approximately 40 m. Orthophotos were created with a resolution of about 5 cm/pixel or less. Georeferencing was accomplished with drone mounted GPS, as well as GPS locating of discrete features on the ground (e.g. the corner of a paved walkway) that appear in the drone image, and georeferenced intentionally placed aerial targets. All imagery is referenced to the national datum for Latvia.

SLAM (Simultaneous Localization and Mapping) technology was also used to create a high resolution, detailed topographic map of the Jungfernhof area (see Figure 17). This technology allows the detailed mapping of an area, while at the same time keeping track of the location of the device within that area. This cutting-edge technology allows detailed map construction of large areas, in much shorter spaces of time. By using SLAM software, the GeoSlam device can simultaneously localize (locate itself in the map) and map (create a virtual map of the location) using SLAM algorithms. We utilized a LiDAR-based SLAM system that used a laser sensor to generate a 3D map of the Jungfernhof site. LiDAR (Light Detection and Ranging) measures the distance to an object (a tree, fence or building for example) by illuminating the object using an active laser "pulse". This LiDAR-based system proved to be a fast and accurate method for drawing a micro-topographic map of the site.

Lastly, a Topcon Total Station was used to collect survey data (x, y and z data), from which many of the maps presented in this report were drawn. It was also used to determine elevational relationships amongst and between GRP Grids and ERT transect lines.

## Results and Discussion

As previously discussed, GPR data was collected in three grids (two in summer 2021 and one in summer 2022). Data was collected along two ERT transect lines in Summer 2021. Also, in summer 2021, using Photogrammetry and Multispectral Aerial Photography from a drone, a photographic base map of the study area was created. Using the hand-held Lidar system "Slam" data was collected in summer 2021 as well, to draw a micro-topographic map of the Jungfernhof site. Land surface surveying was also completed in both summer 2021 and 2022 using a Topcon Total Station.

### Data Collection and Depiction:

The Sensors and Software pulseEKKO™ GPR acquisition system was used for this project. The bottom two panels in figure 4 show the instrument being used to collect data from GPR Grid 3 in summer 2022. The top frame in figure 4 illustrates the typical layout of a GPR grid. In this case, this is GPR Grid 2 from summer 2021. The precise data collected from this grid, and the two others related to the project, is discussed in detail later in this report.

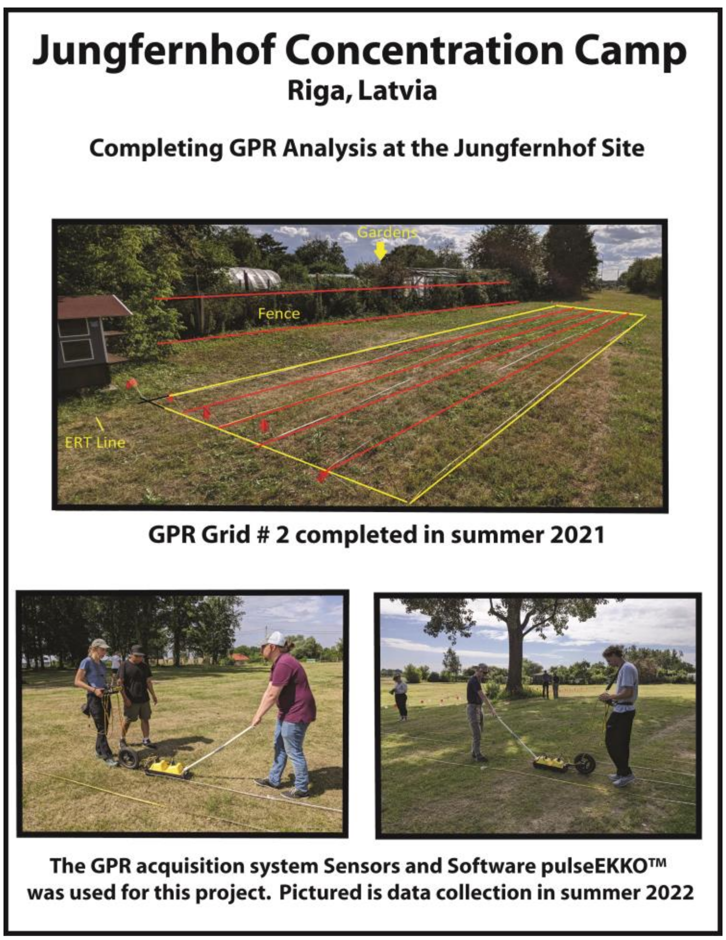



Figure 4 – GPR data acquisition and a typical GPR grid utilized in this project.

As previously noted, photogrammetric data was collected using a drone and related software, and ERT data was collected along two transect lines (in 2021). The drone image is plotted in figure 5. It provides a high-resolution rendering of the study area, upon which data collected using other acquisition techniques can be plotted.

Analysis of reflected energy in the green spectral band indicated no vegetation stress related to possible buried structures, or no areas of unusually healthy vegetation due to, for instance, old garden plot or buried bodies. Analysis of the red spectral band did not indicate any vegetation stress, as well. In itself, the drone image, as processed for figure 5, adds no new information to the existing base of knowledge about the site, but it does provide a media upon which other data products (ERT profiles for example) can be plotted to establish the spatial relationships between the different types of data. Figure 5 establishes the spatial relationship between the location of ERT transect lines 1 and 2, the anomalies found along these transects, and their spatial location within the bounds of the study area. These relationships will be discussed in more detail, later in this report.

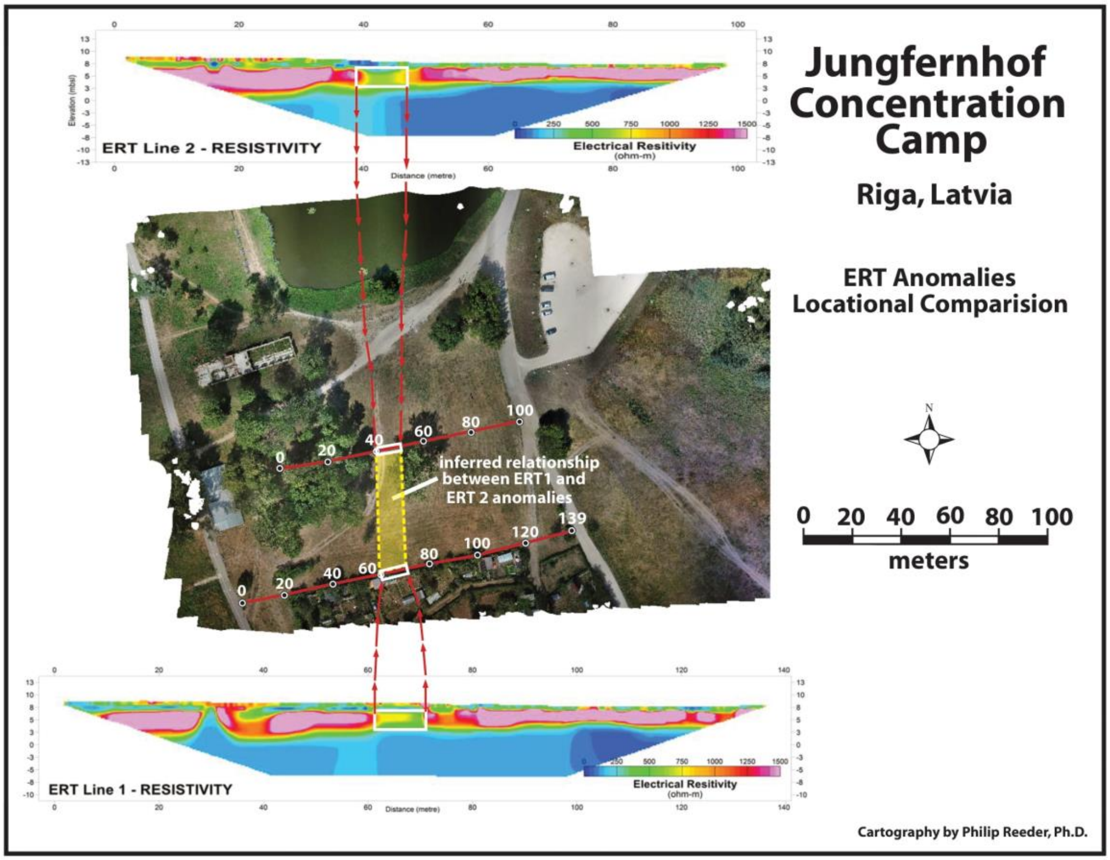



Figure 5 – Drone image of the present-day Jungfernhof Camp area, with the location of ERT transect lines 1 and 3 included, as well as the cross-sectional profiles of these transects.

The collection of spatially distributed data, like GPR and ERT, requires the creation of a base map, upon which the location of where the data was collected, and in some cases, some data attributes, can be plotted. Figure 6 is the base map for this project. It possesses the basic elements of the present-day site, like the pond, roads, parking lots, walking path and river, as well as hold-overs from previous times like the ruins of the Mazjumpravas Manor, and the location plotted as "current building," which is built at the site of a former (older) structure on the site. The base map also provides the vehicle for plotting the location of sites of GPR and ERT data collection. Figure 6 shows the location of ERT lines 1 and 2, and GPR grids 1 and 2, thus representing data acquisition targets from summer 2021. It also highlights the location of an important ERT anomaly along line1, and its spatial relationship with a GPR anomaly in grid 2. Cross-sections of these anomalies are also presented so that visual comparisons can be made. Using data depiction graphics software, like Adobe Illustrator, allows layers of spatial/map data to be created, and depicted in various combinations, thus facilitating the creation of numerous other maps, based on the original base map. More of these type maps are presented throughout this report.

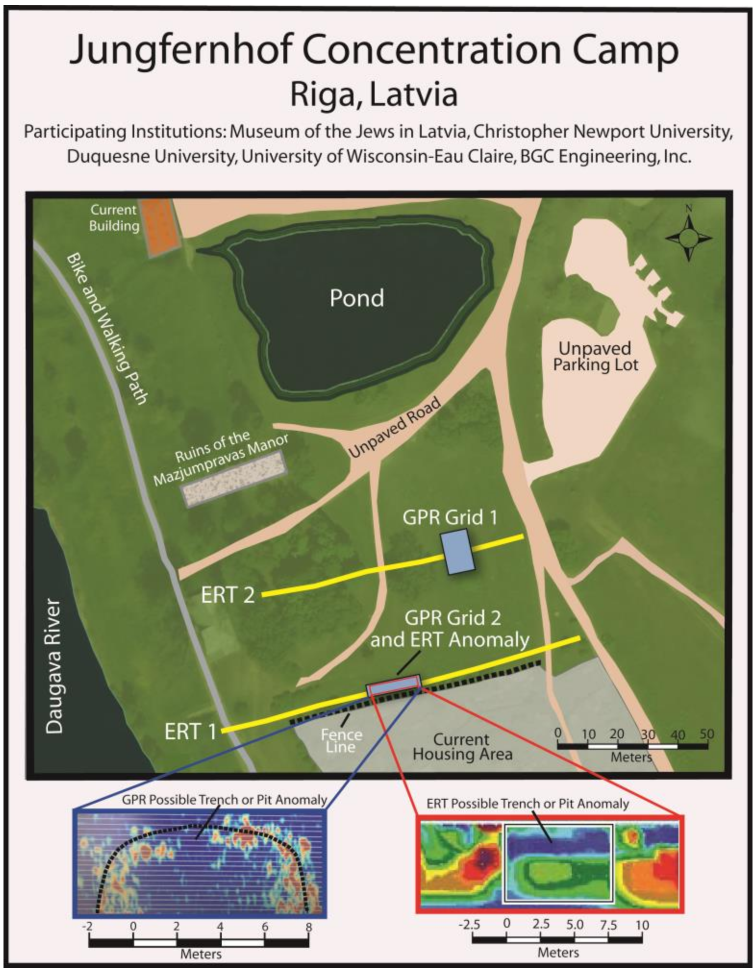



Figure 6 – Base map for the Jungfernhof Concentration Camp, with location data for ERT lines 1 and 2, and GPR Grids 1 and 2, and selected data plots included.

Figure 7 is similar to figure 6, but it has more elements added to the base map. The location of the ERT anomaly along line 2, between 60 and 75 meters, has been added. Additionally, since the ERT line 2 anomaly essentially lines up, in an almost due north-south direction, with the ERT line 1 and GPR Grid 2 anomalies, a shaded area representing the possible relationship between the two anomalies (a possible pit and/or trench feature) has been added to the base map. An additional cross-section, for the anomaly in ERT line 1, has also been added. Before any assumptions regarding the area between the ERT line 1/GPR Grid 2 anomalies, and the ERT line 2 anomaly can be finalized, additional data collection in the area between the two anomalies was required. In 2022, GPR Grid 3 was located in this area. The data from Grid 3, and its relationship with the anomaly in ERT line 1 and GPR Grid 2 are discussed later in this report.

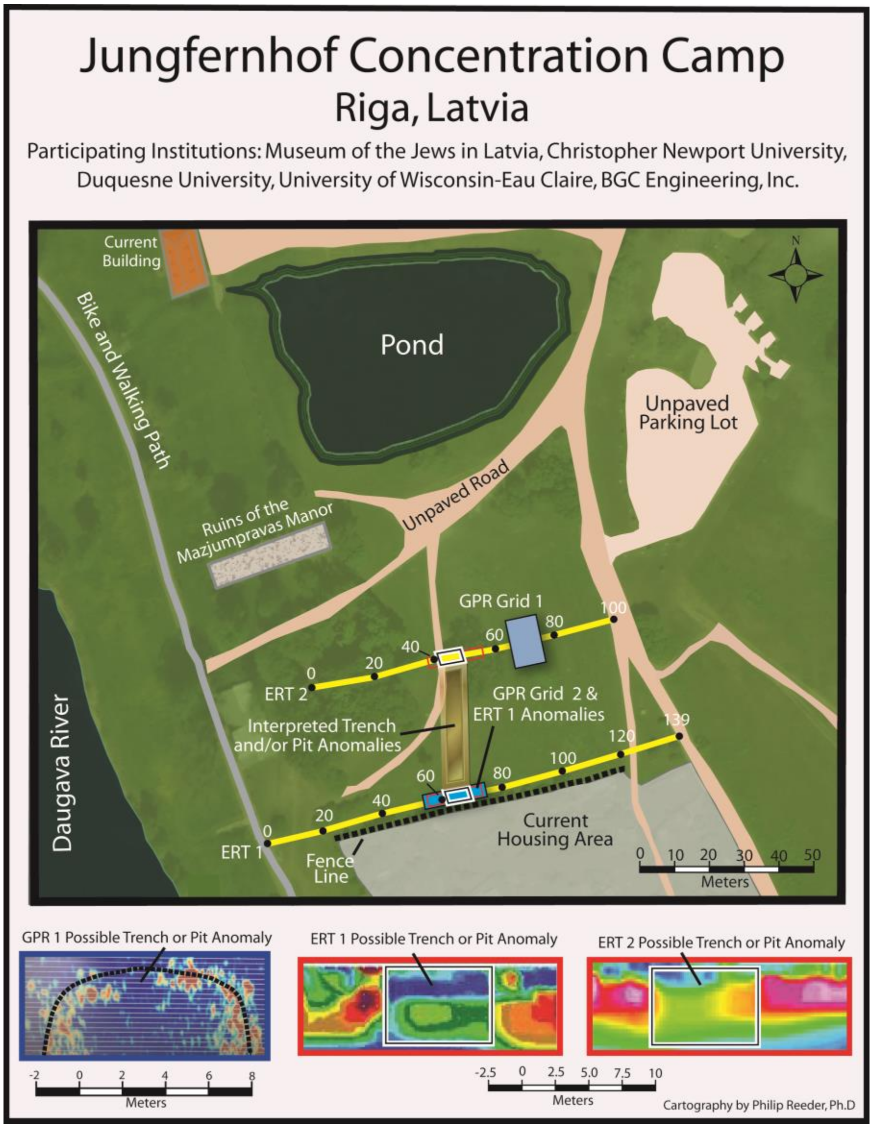



Figure 7 – Updated version of the project base map, with location data for the anomaly in ERT line 2 added (cross-section added as well), along with the inferred relationships between the GPR Grid 2, ERT line 1 and ERT line 2 anomalies.

The location of Grid 1 is found in figure 7. For GPR Grid 1, which intersects ERT line 2 between approximately 65 and 75 meters, no clear anomalies were interpreted to appear in the grid's data slices. These slices were created every 0.05 meters from the land surface to a depth of 1.25 meters. Figure 8 contains four representative data slices, from the depths: 0.20 to 0.25 meters, 0.40 to 0.45 meters, 1.00 to 1.05 meters and 2.25 to 1.55 meters. The shallowest grid featured in figure 6 (0.20 to 0.25 m) does possess a very clear feature in the upper (north) central part of the grid, and this feature persists to a depth of 0.40 to 0.45 meters below the surface (upper right panel in figure 8). Given the shallow nature of the feature, it's very sharp edges, and the fact that it quickly ends just below 0.50 meters, this feature is interpreted to be a piece of debris, possibly from the Jungfernhof camp, that was buried by the construction activities in the area that created the current park occupying the site. The "noise" (multiple random patterns) in the 0.20 to 0.25 slice, are interpreted to be silt size overbank deposits from the Daugava River, which are deposited over the area during high discharge events (floods). With depth, the presence of these deposits diminishes, and no natural or anthropogenic disturbances are detected. With a high degree of certainty, it is posited that GRP Grid 1 does not intersect any type of mass grave, burial pit or trench.

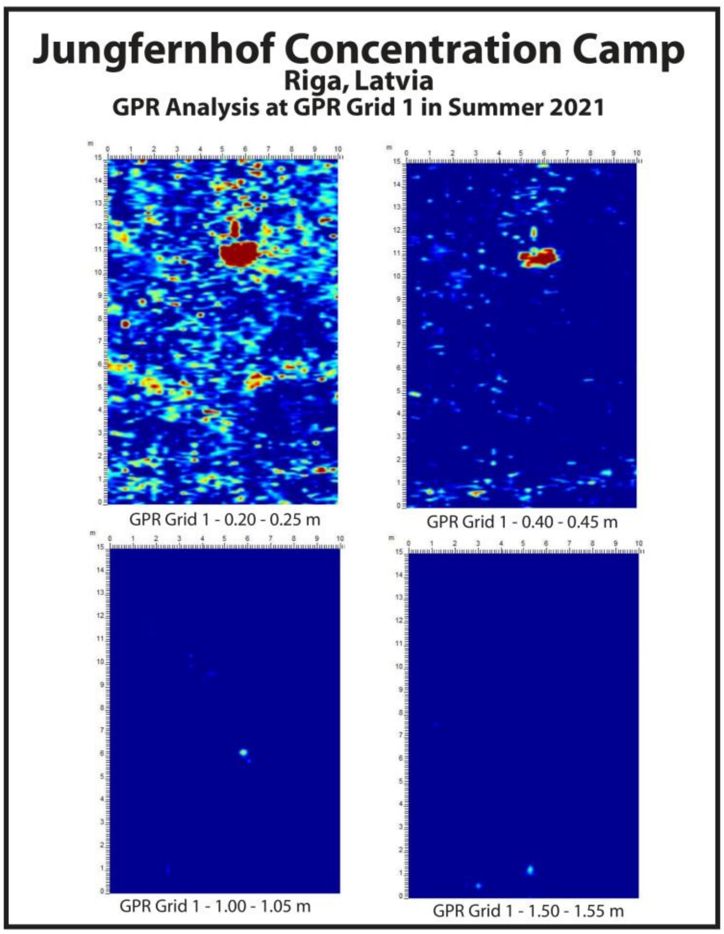



Figure 8 – Four data slices from GRP Grid 1.

Figure 9 presents GPR data related to grid 2. The spatial location of this grid and its relationship to the location of ERT lines 1 and 2, is presented in figures 6, 7, 18, 19 and 23. In figure 9, the anomaly is presented using two different depiction scenarios. In the upper plot, the strength of the signal indicating the presence of the anomaly is related to height. The stronger the signal, the higher the peak. Hence, the strength of the signal is consistently high across the arc shaped feature. One interesting phenomenon is the gap in the signal near the top (up) of the anomaly (indicated by a red circle). This feature can be clearly seen in the plan view (looking from directly above) in the bottom plot in figure 9. This GPR anomaly is very strong, and is definitely indicating the presence of a subsurface feature. This assertion is based upon the strength of the signal, the shape of the anomaly, and the fact that it correlates precisely with an ERT anomaly in ERT line 1. Figures 5-7 clearly illustrate this relationship. Additionally, later in this report, this feature is discussed in an historical context, relating the location and nature of this anomaly to former (now gone) features at the Jungfernhof Camp.

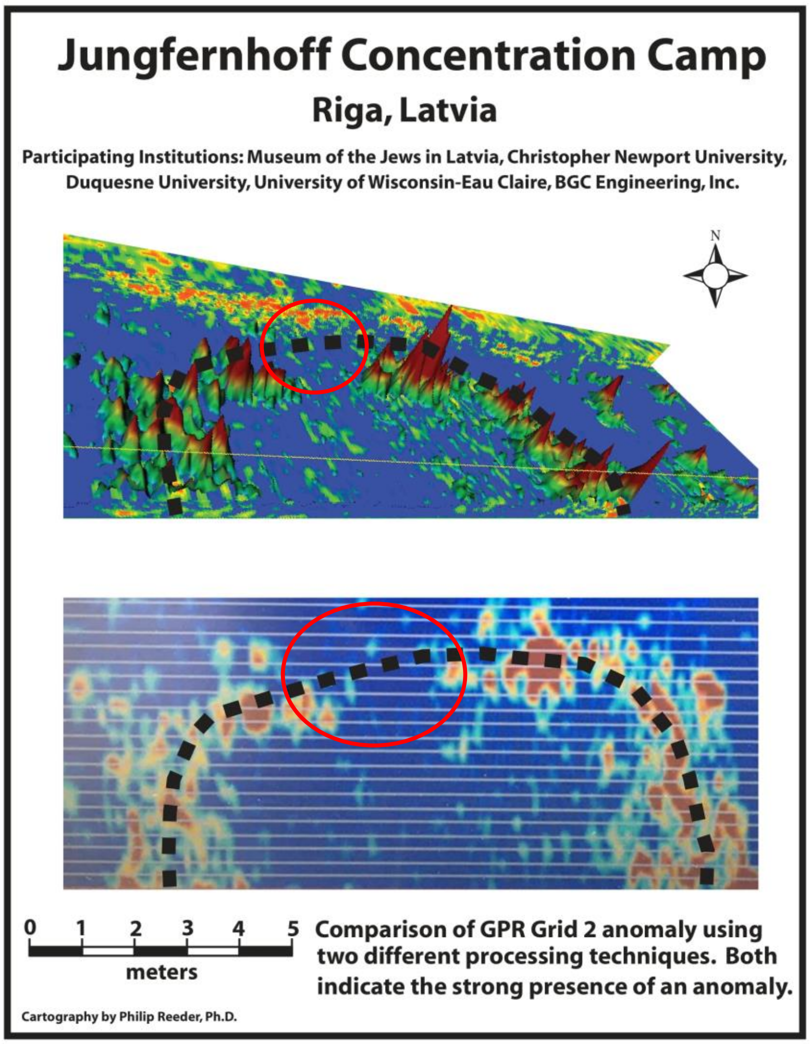



Figure 9 – Comparison of two ways to depict the GPR anomaly in Grid 2.

Figure 10 depicts ERT profiles from lines 1 and 2, with the anomalies that are present highlighted within a rectangular box. The boxes are also numbered and notations about each anomaly have been provided at the bottom of the diagram. ERT line 1 contains two resistivity anomalies (see the methods section for an explanation of ERT resistivity measurements and cross-sectional profiles). Anomaly 2 has been previously discussed in detail, and it correlates precisely with the anomaly in GPR Grid 2 (see figures 6 and 7). Anomaly 1 in ERT line 1, has not yet been discussed in detail. It will be discussed later in this report in the context of matching the geophysical anomalies that are being detected, with former features that existed at the site. Of note in figure 10 is the fact that ERT anomaly 1 is a resistivity anomaly, but an induced polarization (IP)anomaly also exists at the same location. This is depicted as number 4 in figure 9. The IP anomaly indicates the presence of buried metal at the same location where the resistivity anomaly exists. For a detailed explanation of IP anomalies, see the methods section of this report. The significance of this IP anomaly will also be discussed in more detail later in this report.

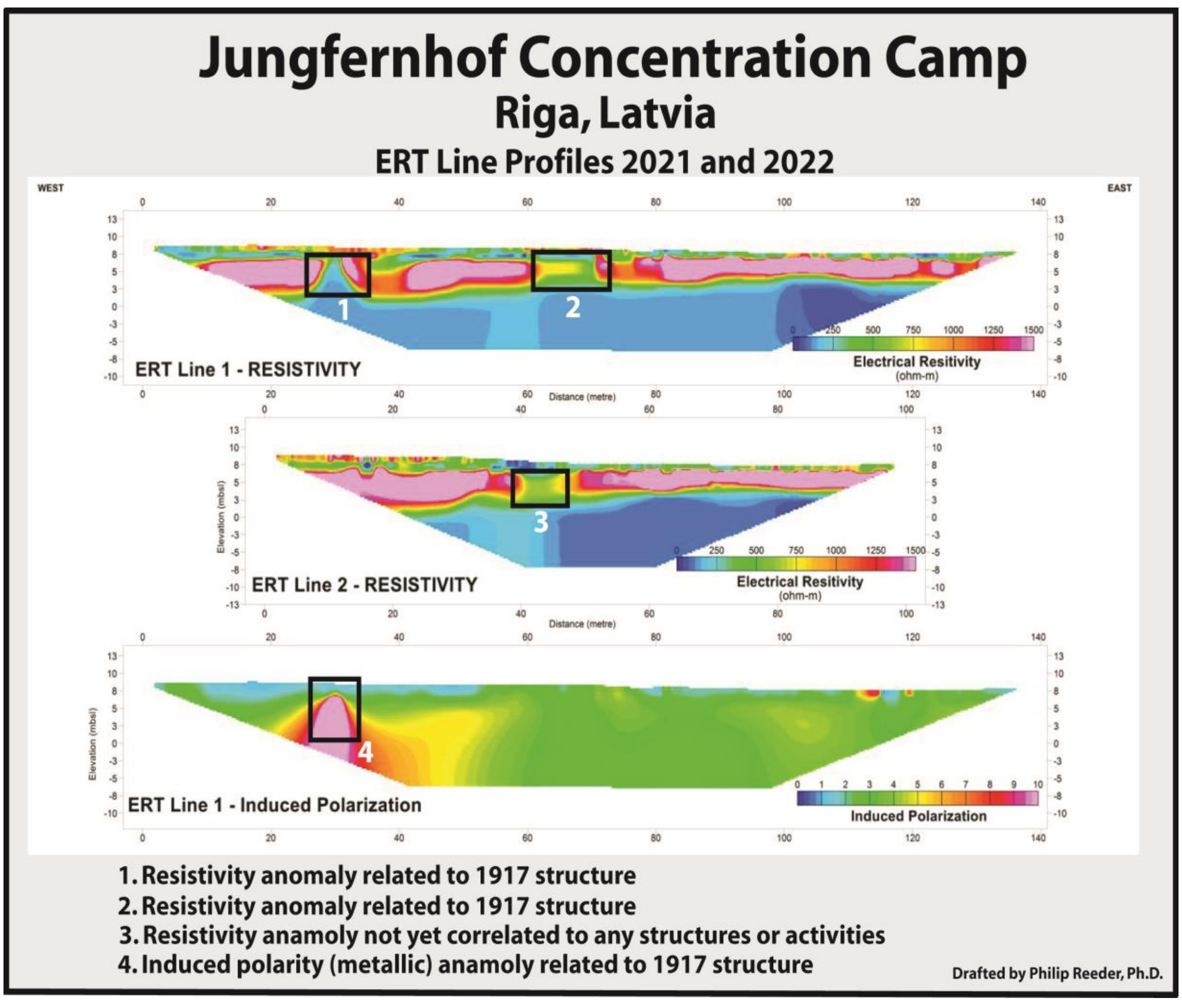



Figure 10 – Resistivity ERT profiles for lines 1 and 2, with feature of interest highlighted, and a profile of an IP anomaly in ERT line 1.

### The Interpretation of Map Overlays:

As previously noted, a 1917 air photograph of the Jungfernhof Camp area exist was obtained. Satellite images from Google Earth have coverage from 1985 to 2022. Unfortunately, the portion of Latvia where Jungfernhof is located, was not on the flight path for the Luftwaffe 1944 air photograph program, hence no World War II era air photos of the site exist. Various types of maps for the area do exist. Most are at map scales that depict too large of an area, and thus are not useful for this project. Several maps, accessed through the website: https://vesture.dodies.lv/, were at scales that rendered them useful, hence maps from 1942 and 1947 were accessed through this site.

One of the major objectives of the research for summers 2021 and 2022, was to relate features that exist presently at the Jungfernhof site, or those found during geophysical and spatial analysis research, with features from the camp in 1917, 1942 and 1947. This analysis was facilitated by creating map, air photo and satellite image overlays, or comparative diagrams wherein features from different time periods can be compared.

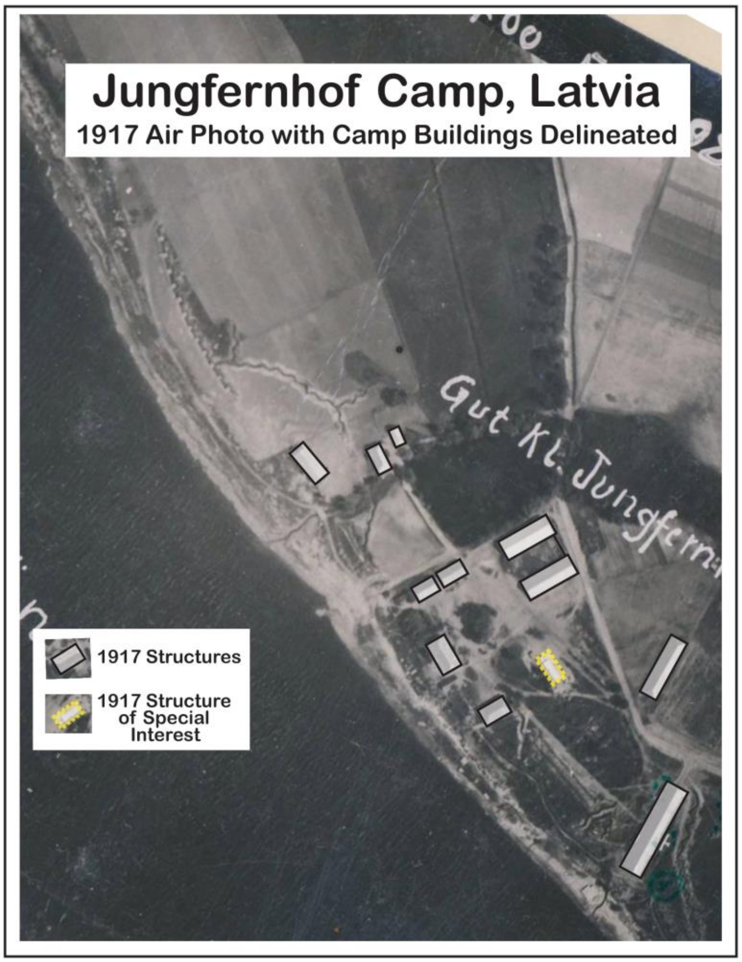



Figure 11 – The 1917 air photo of the Jungfernhof area, with the 1917 era buildings delineated.

Figure 11 is a 1917 air photo of what became the Jungfernhof Camp. The buildings in and around the camp area were delineated in a layer superimposed upon the air photo. This layer was then transferred to the 2022 satellite image for the area, hence delineating the features from the 1917 air photo, on a 2022 satellite image (see Figure 12). Present on the 1917 air photo are 12 building of various sizes and shapes. It appears that some type of structure, or multiple structures with roofs occupy the site of the Mazjumprava Manor house. Additionally, one of the structures (highlighted as yellow), based upon the location of GPR Grid 2 and ERT line 1 anomalies, was deemed as a location requiring additional analysis, which is discussed in detail later in this report.

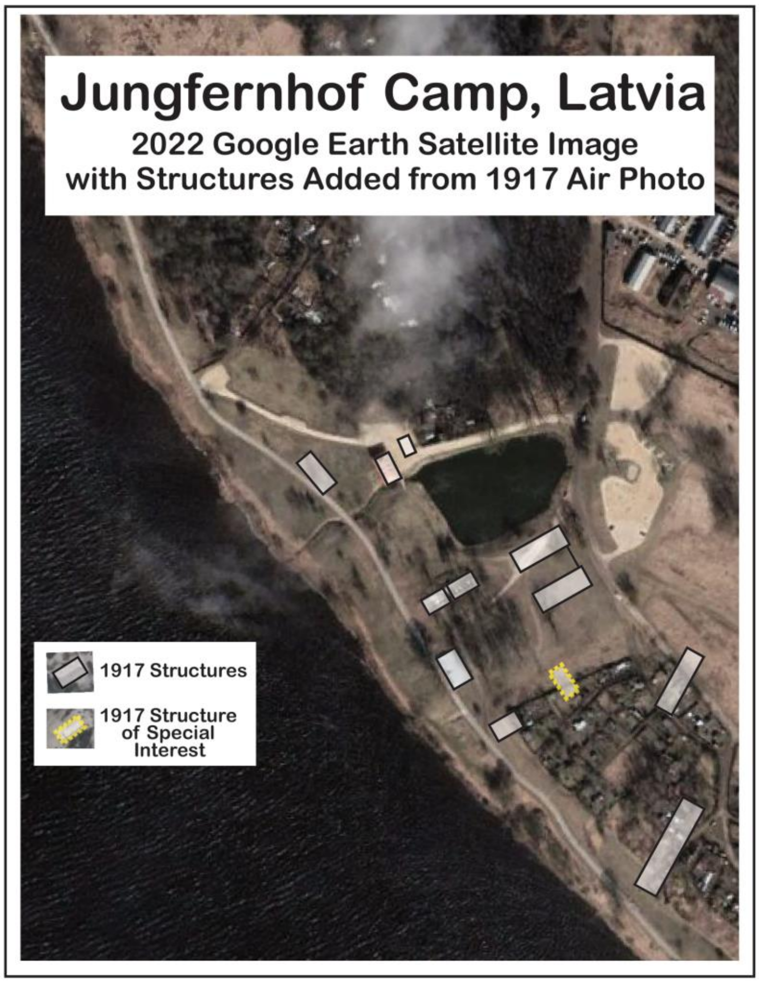



Figure 12 – Building locations from the 1917 air photo of the Jungfernhof area, layered upon the 2022 satellite image of the area.

The placement of the 1917 buildings, on the 2022 satellite image reveals a number of important relationships (Figure 12). First, and foremost, as noted in the discussion related to figure 11, the structure highlighted as yellow, places perfectly along the fence that separates the open areas associated with the Jungfernhof Camp location, from the current summer-housing/garden area to the southeast. As noted, the GPR/ERT anomalies plot precisely over this position.  Also, there are two side by side, northeast by southwest oriented structures (red circle) that correlate with open areas in the center of the site, that are located just south of the pond.  The structure closest to the center of the site (white circle), and along the river, still exists in some form, although it was rebuilt on the same site at some point.  As noted for figure 11, there are structures occupying the now ruined Mazjumprava Manor house (orange circle), and there are 1917 era structures partially in and partially outside the summer/garden area (yellow circles).  There are also three structures north-northwest of the pond, with one of these structures still existing in some form (green circle).  Lastly, there is a structure (black circle) located to the southwest of the highlighted feature.  This structure coincides with the location of a resistivity/IP anomaly along ERT line 1, near the zero origin point and Daugava River.  These relationships and this feature are discussed later in this report.

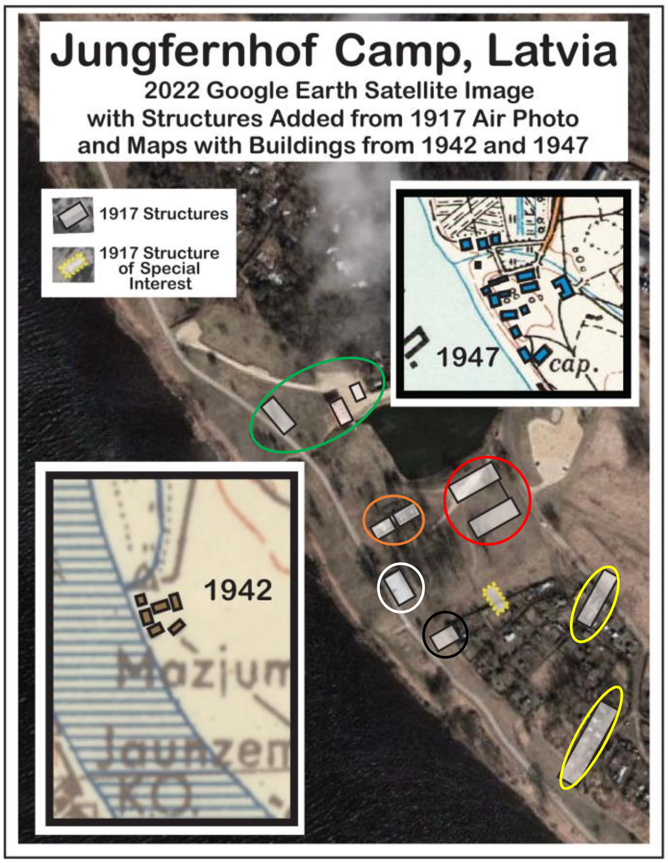



Figure 13 – A 2022 satellite image with the location of the 1917 buildings positioned on the image, and maps from 1942 and 1947 inserted for comparison.

Maps for 1942 and 1947 were accessed through the website: https://vesture.dodies.lv/, and plotted on the 2022 satellite image to show the presence or absence of the 1917 buildings in 1942 and 1947 (Figure 13).  The lack of structures on the 1942 map, that are present on both the 1917 air photo, and 1947 map indicates that the 1942 map provides an inaccurate representation of the area.  Figure 14 further illuminates this fact.

As presented and explained in Figure 14, there are many fewer structures in the 1942 map compared to the 1917 air photo or the 1947 map. On the 1917 air photo there are 12 structures present. On the 1947 map (two years after the end of World War II in Europe), there are 17 structures present. On the 1942 map, there are only six structures present. It is very unlikely that structures that were present in 1917 and present in 1947, were not present in 1942. Given that 1942 was the height of the Nazi occupation, and the war in Eastern Europe, it is not likely that the depiction of the Jungfernhof Camp on the 1942 map is accurate. Hence, this map is not used for any further analysis for this project.

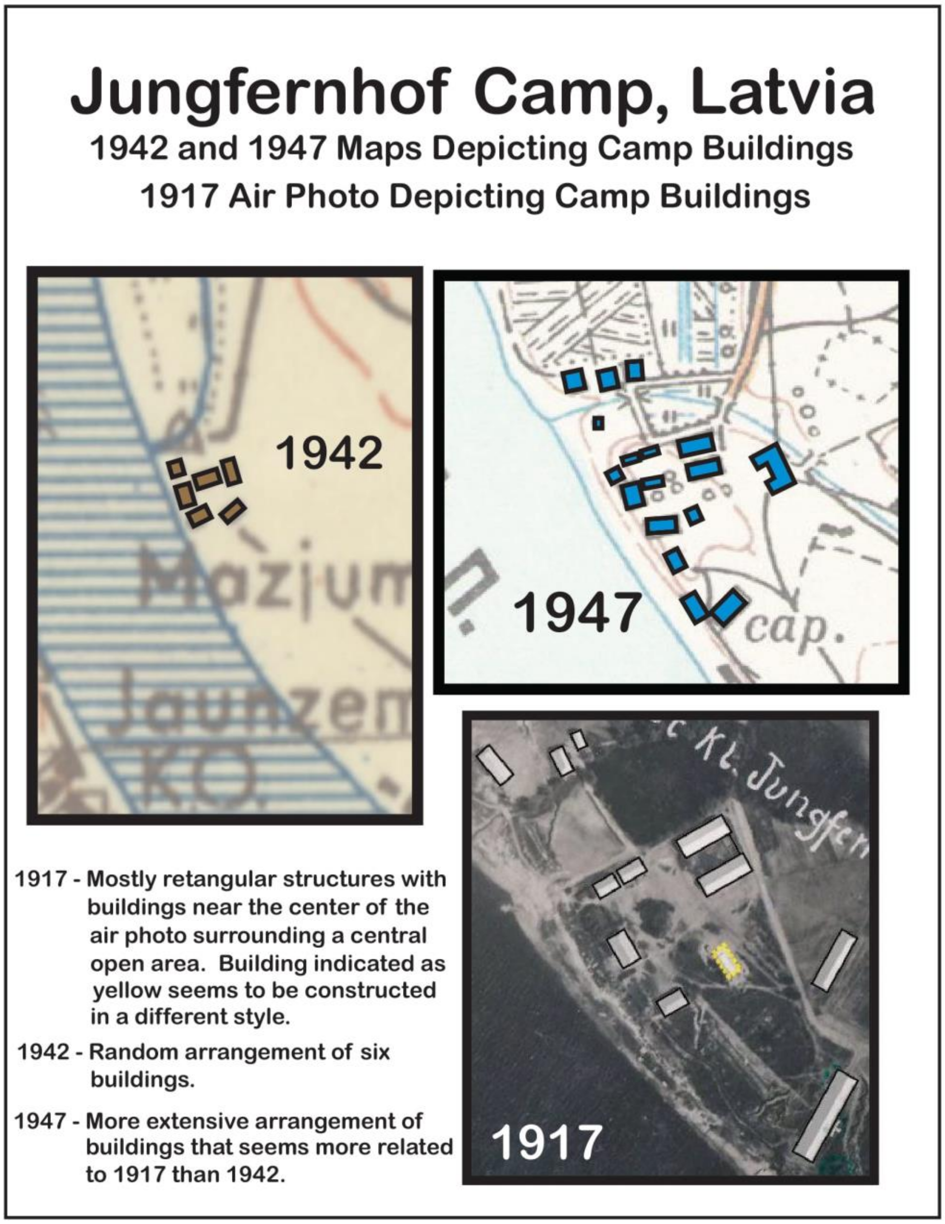



Figure 14 – Comparison of the 1917 air photo of the Jungfernhof Camp area, with maps from 1942 and 1947, comments added about the air photo and map content.

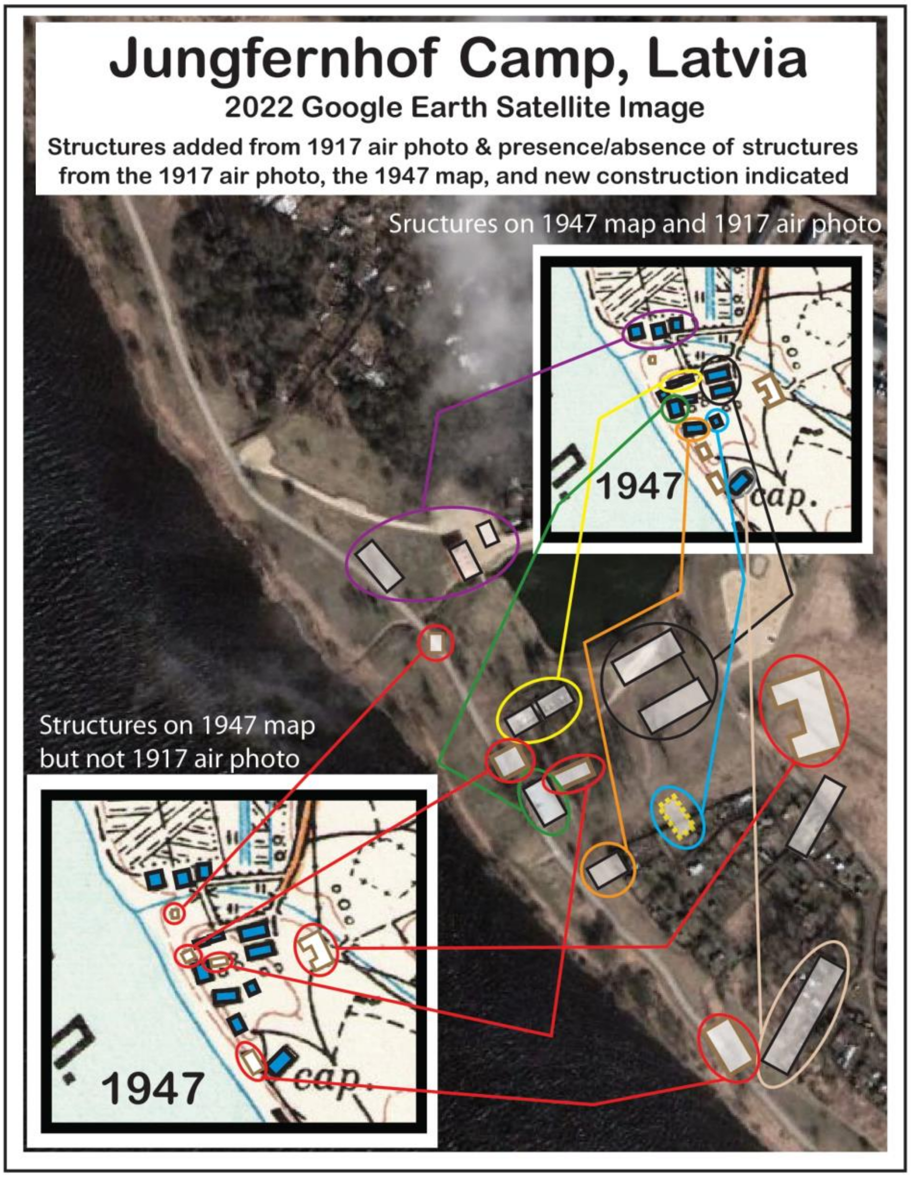



Figure 15 – 2022 satellite image with the 1917 structure locations plotted on the satellite image, and the presence or absence of structures from the 1917 air photo and 1947 map, and new construction (between 1917 and 1947) indicated.

As already established in the discussion related to figures 13 and 14, there are 12 buildings/structures present on the 1917 air photo. Those structures are plotted on the 2022 satellite image in figure 15. The 1947 map is also plotted, twice, with the version of the map plotted in the upper right of figure 15 highlighting the structures that are present in both 1917 and 1947. Looking at this in more detail, three structures from 1917 air photo (plotted on the satellite image) that are highlighted within the purple circle are also present on the 1947 map. Further, a present-day structure, constructed in 2016 on the ruins of this earlier structure, exists at the location of the middle structure within the purple circle. The structure(s) highlighted within the yellow circles is the Mazjumprava Manor, which existed in both 1917 and 1947. The ruins of this structure are still present at the Jungfernhof Site. The structure highlighted within the green circles is present in both 1917 and 1947, and a present-day structure, which was built in 2018, now exists on the ruins of this structure. The elongated, side-by-side rectangular structures that are highlighted within the black circles are present on both the 1917 air photo and 1947 map, but no structure exists at this site today. The same can be said for the structures highlighted in the orange, blue and light brown circles. These structures are present on both the 1917 air photo and 1947 map, and no visible structures exist at these sites today, but both GPR and ERT anomalies were detected at the blue circle location, and ERT resistivity and IP anomalies were detected at the orange circle location. These locations are discussed further in conjunction with figures 16 and 17.

The 1947 map in the lower left corner of figure 15, highlights structures, in red circles, that are on the 1947 map, but not on the 1917 air photo. Hence, these buildings/structures were constructed sometime between 1917 and 1947. There is no indication of these structures on any of the satellite images available through Google Earth, which cover the years 1985 to present. It is not known when these structures were demolished during the period 1947 to 1985.

The structure that was referred to as "being within the blue circle" in the discussion related to figure 15, and "highlighted as yellow" for figure 12, is discussed next. The GPR data collected from Grid 2 in 2021 is presented in Figure 16 (also see figure 9). As already established as part of the discussion for figures 11 and 12, and presented in figures 9, and 13-15, a structure existed at the location where this anomaly was detected. Some of the characteristics of this anomaly were presented and discussed in conjunction with figure 9, and further details are presented in figure 16. The structure associated with this anomaly is estimated to be 9 x 15 meters in size, and it is oriented north-northwest by south-southeast along an axis running from 340 degree to 160 degrees (see figure 17 and 18). As seen is figure 16, the anomaly exhibits sharp right-angle bends. Features possessing this geometry are interpreted as human-constructed or modified, because natural processes, or suites of processes working in concert and affecting near-surface earth materials, do not form features at sharp right angles. Additionally, there is a gap (opening) between the two right angle bend anomalies, indicating that the anomaly is not one continuous feature. This opening, as indicated by the white arrow in figure 16, and the red circles in figure 9, is interpreted to be the entryway into a building. This is based on the assertion that a feature like a wall will exhibit a continuous anomaly along its entire course. An entryway into a building will manifest as void space (no anomaly present) on a GPR slice, often flanked by anomalies that are the walls that are on the flanks of the entryway. This describes precisely what is presented in figure 16. Further, the anomaly in figures 9 and 16 represents only part of the building that stood on the site at this location in 1917, 1947, and beyond. Because this structure is estimated to have been approximately 9 meters wide and 15 meters long, and because the summer-housing/garden area is now built over approximately 70% of the remains of that structure, only 30% was accessible for GPR and ERT analysis.

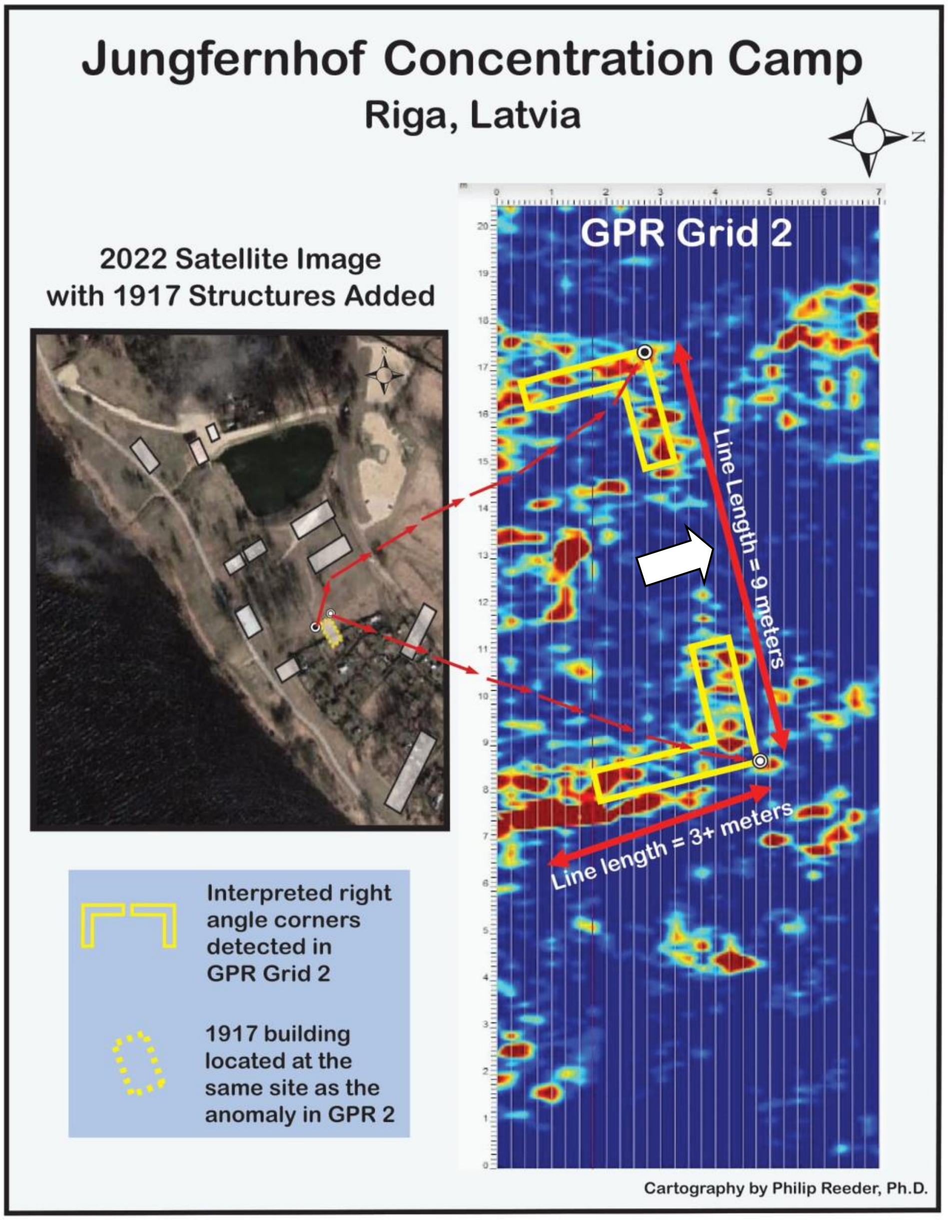
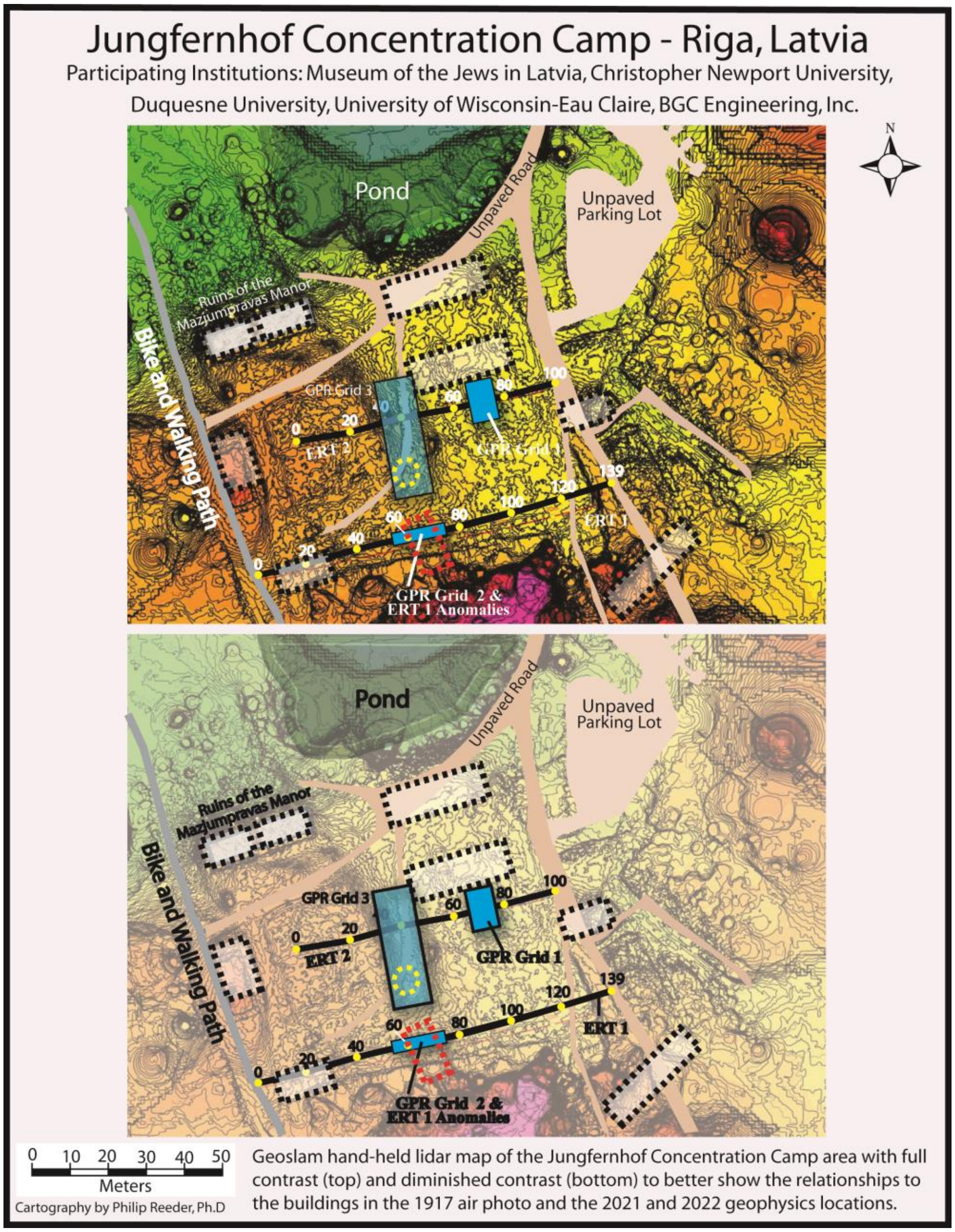



Figure 16 – GPR Grid 2 anomaly and related information.

This structure, as well as the location of the 1917 buildings, the ERT lines and the GPR grids (including grid 3 from summer 2022), are plotted on the map of the Jungfernhof Camp site that was created using the GeoSlam hand-held lidar device. This map was created to assess the micro-topography of the site to determine if topographic depressions exist, which may be related to features in the subsurface. The top panel of figure 17 is presented at full contrast, and no micro-topographic anomalies can be detected. The map in the bottom panel is presented with a lower contrast, and although the 1917 building locations, and the location of the ERT lines and GPR grids are clearer, again no micro-topographic anomalies are detected. Of note, in the bottom panel of figure 17, is the 1917 (also present in 1947) structure at the west end of ERT line 1. No GPR grid was placed in this area, but ERT detected both a resistivity and IP anomaly at this location. This anomaly, as well as additional information related to the ERT line 1/GPR Grid 2 anomalies (discussed as related to figure 16), are discussed below in relation to Figure 18.




Geoslam hand-held lidar map of the Jungfernhof Concentration Camp area with full contrast (top) and diminished contrast (bottom) to better show the relationships to the buildings in the 1917 air photo and the 2021 and 2022 geophysics locations.

Figure 17 – Micro-topographic map of the Jungfernhof Camp area created using a GeoSlam hand-held lidar system, with 1917 building locations, and 2021 and 2022 ERT line and GPR Grid locations included.

Figure 18 more clearly shows the location of the 1917 building located at the west end of ERT line 1 (near the Daugava River). Also, an inserted cut out from the 1917 air photo, shows the building that was once located at the intersection of the ERT line 1/GPR Grid 2 anomalies.

Refer back to figure 10 regarding information about the resistivity/IP anomalies located at the west end of ERT line 1. In the upper ERT profile in figure 10, in the portion of the line designated as #1, an obvious anomaly exists, where the layers of earth materials (pink in color in the profile) are clearly truncated. The width of this feature is on the order of 4-5 meters and the depth extends down to below 4 meters beneath the surface. The IP anomaly, shown in the bottom profile plotted in figure 10, is located precisely in the same position as the resistivity anomaly (which is to be expected). This type of anomaly (IP) indicates the presence of metal at the site of the anomaly. As previously noted, a building present on the 1917 air photo and 1947 map (see figures 14, 15, 17 and 18), is located at the same site as the anomaly. Hence, the ERT resistivity and IP anomalies are resultant upon the fact that this building once existed at this precise location.

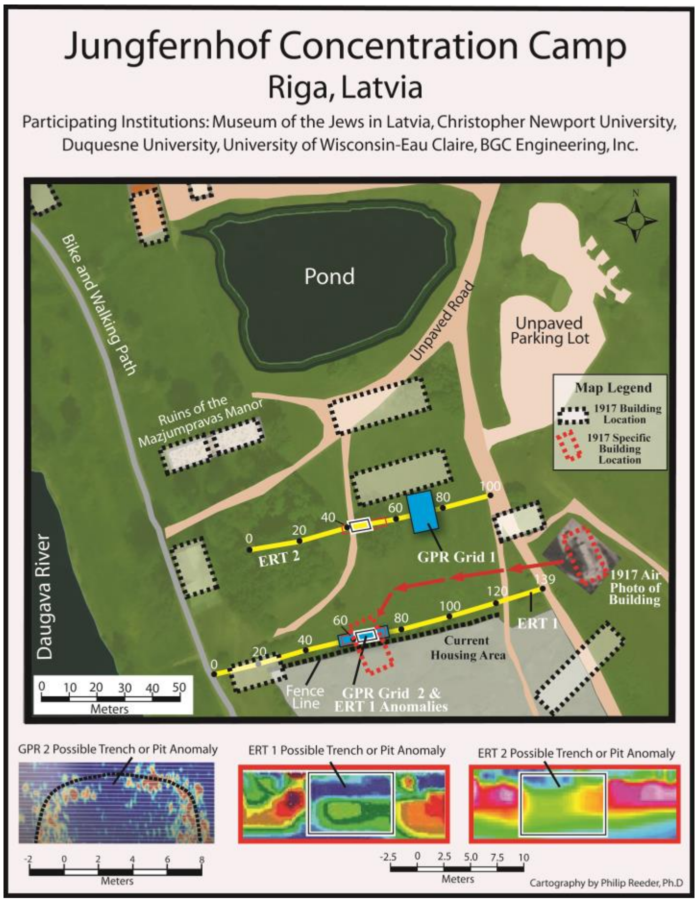



Figure 18 – Base map of the Jungfernhof Concentration Camp study site, with the 1917 buildings, ERT lines 1 and 2, and GPR Grid 1 and 2 locations included, and a cut out of the specific building of interest added.

Figure 19 is similar in form and content to the base map presented in figure 18, with one acceptation. The base map in figure 19 has the location of GPR Grid 3 (from summer 2022) added, as well as the location, and plan view, of an anomaly detected in one of the slices from this grid. This grid, and four associated slices, are discussed in relation to figures 20-22.

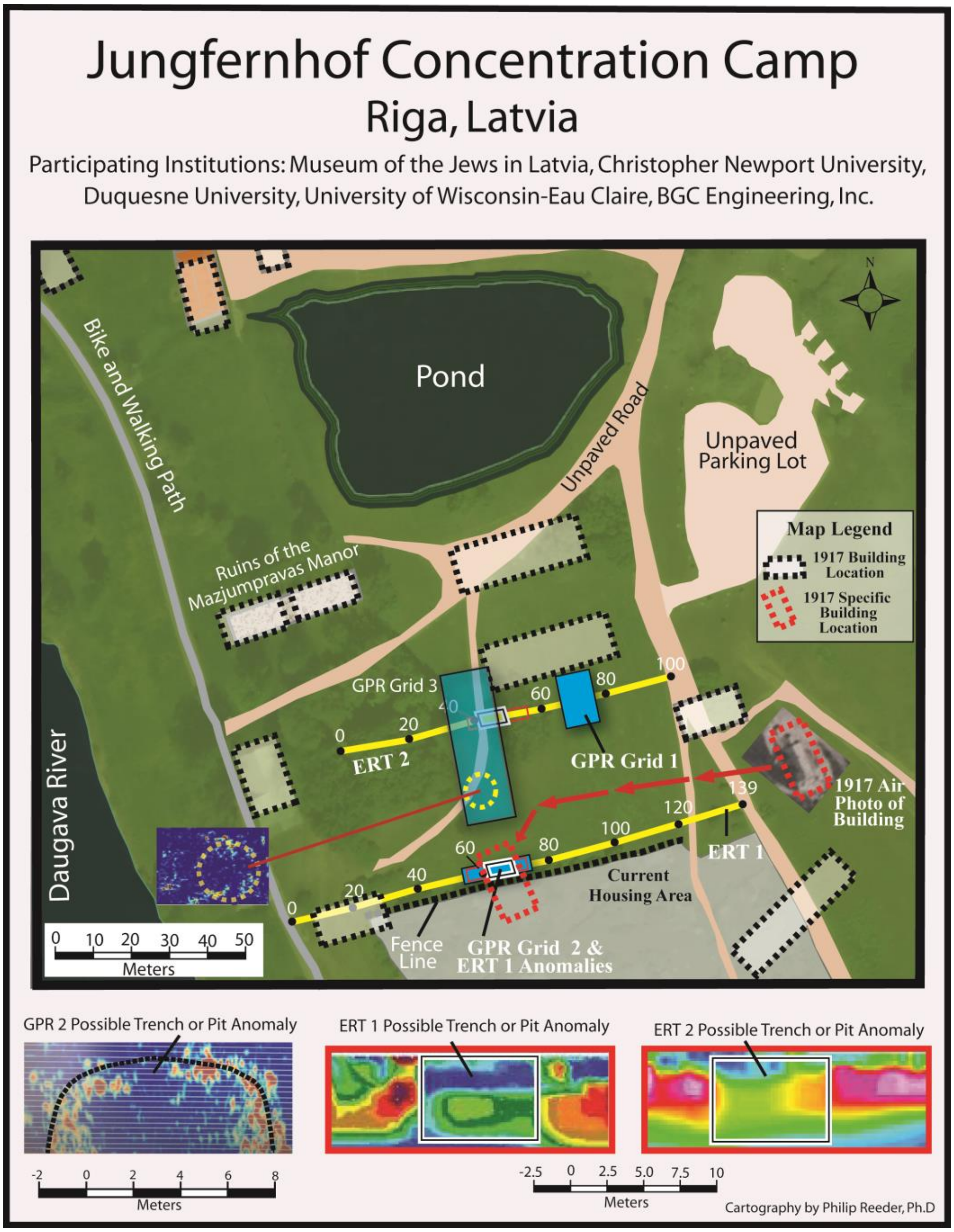



Figure 19 – Base map of the Jungfernhof Concentration Camp study site, with the 1917 buildings, ERT lines 1 and 2, GPR Grid 1 and 2 locations included, as well as a cut out of the specific building of interest, and the location and a slice from GPR Grid 3 added.

Grid 3, from summer 2022, measured 15 x 40 meters with the main axis of the grid running in a north-northwest to south-southeast direction (see Figure 19). Data slices were created for GPR Grid 3 every 0.05 meters, to a depth of 2.0 meters. Hence, 40 data slices were created. From these 40 data slices, six were selected as being representative of the GPR data collected, and they are discussed below in groups of two, as presented in three figures (figures 20-22). Please note, the overall size (length), and hence data collection area, for Grid 3 was 40 meters, but because of a persistent processing error in the region from 35 to 40 meters along the length of the grid, this data was edited out of the data slices in figures 20 to 22. If this processing error is eventually rectified, this data can be added back into the data plots in the future.

The data slices presented in Figure 20, are indicative of the data in the upper half of the grid. There are no anomalous features detected, and the patterns are indicative of overbank deposits from high discharge events (floods) along the Daugava River, and its floodplain, where the Jungfernhof Camp site is located. The data slice presented at the bottom of figure 20, is at a depth from 0.70 to 0.75 meters below the surface.

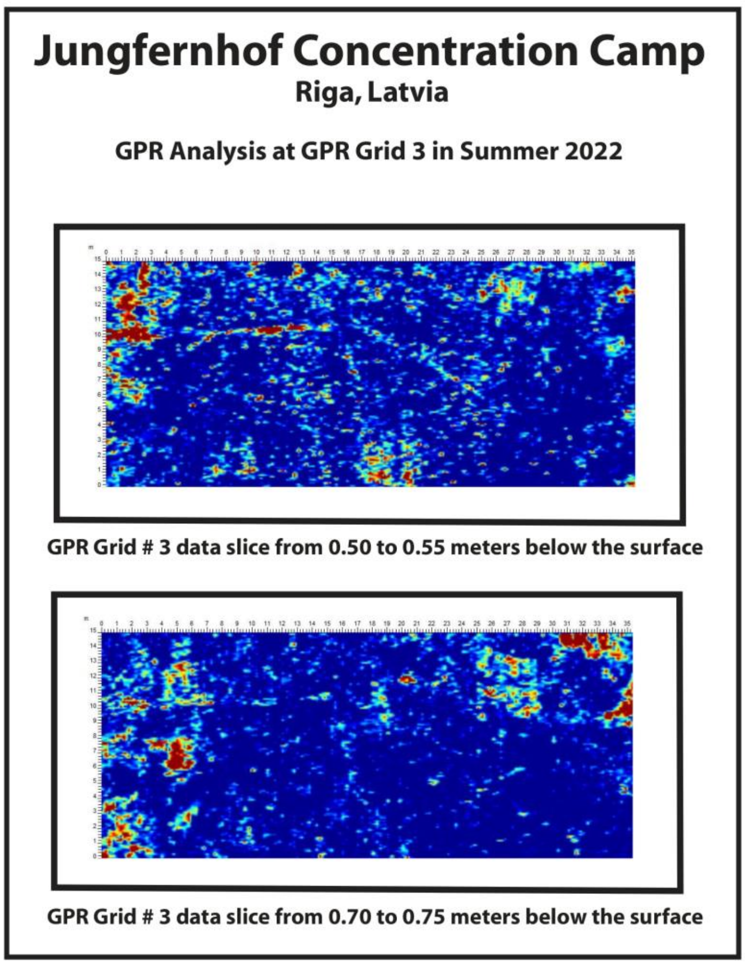



Figure 20 – GPR data slices from GPR Grid 3 (summer 2022).

The data slices between 0.80 meters and 1.15 meters show a slow shift from profiles dominated by silt over bank deposits, most likely related to high discharge events over the past 40 years (estimate), to older materials that are deposits that were in-situ 80 years ago during the time the area was occupied by the Jungfernhof Concentration Camp. The data slice presented in the upper portion of figure 21, is from 1.15 to 1.20 meters below the current land surface. At this depth, a circular anomaly begins to appear, as indicated by the circle drawn over the area. This same anomalous feature continues to lower depths, and becomes even more pronounced in the data slice from between 1.30 and 1.35 meters below the current land surface.

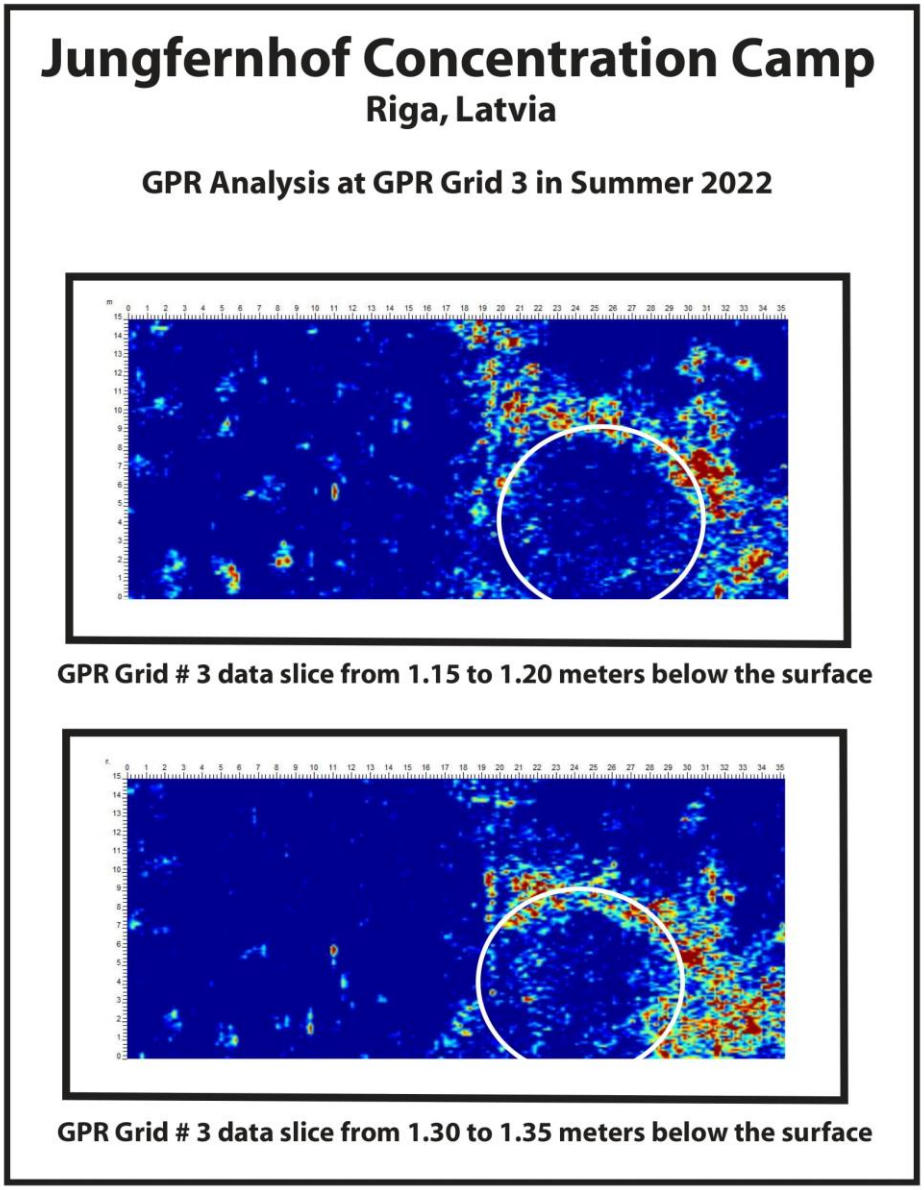



Figure 21 – GPR data slices from GPR Grid 3 (summer 2022), with an anomalous feature highlighted.

The data slices from between 1.15 meters and 1.35 meters (presented in figure 21) show a marked shift from the profiles dominated by silt over bank deposits in figure 20. The feature that appears in the data slices in figure 21, persist and are found in the data slices as well for depths between 1.85 and 1.95 meters below the current land surface (Figure 22). At the deepest signal penetration depth of 1.95 meters, the anomaly still appears in the data slice. Based on this observation, it can be postulated that the features continue to even greater depths.

The anomaly circled in figures 21 and 22 is fairly round in plan view (looking from above), and measures approximately 10 meters across. At this point, all that can be stated about this feature is that it begins at a depth of approximately 1.0 meter below the current land surface, it extends to a depth of 2.0 meters (and beyond) below the current land surface, and it is approximately 10 meters in diameter.

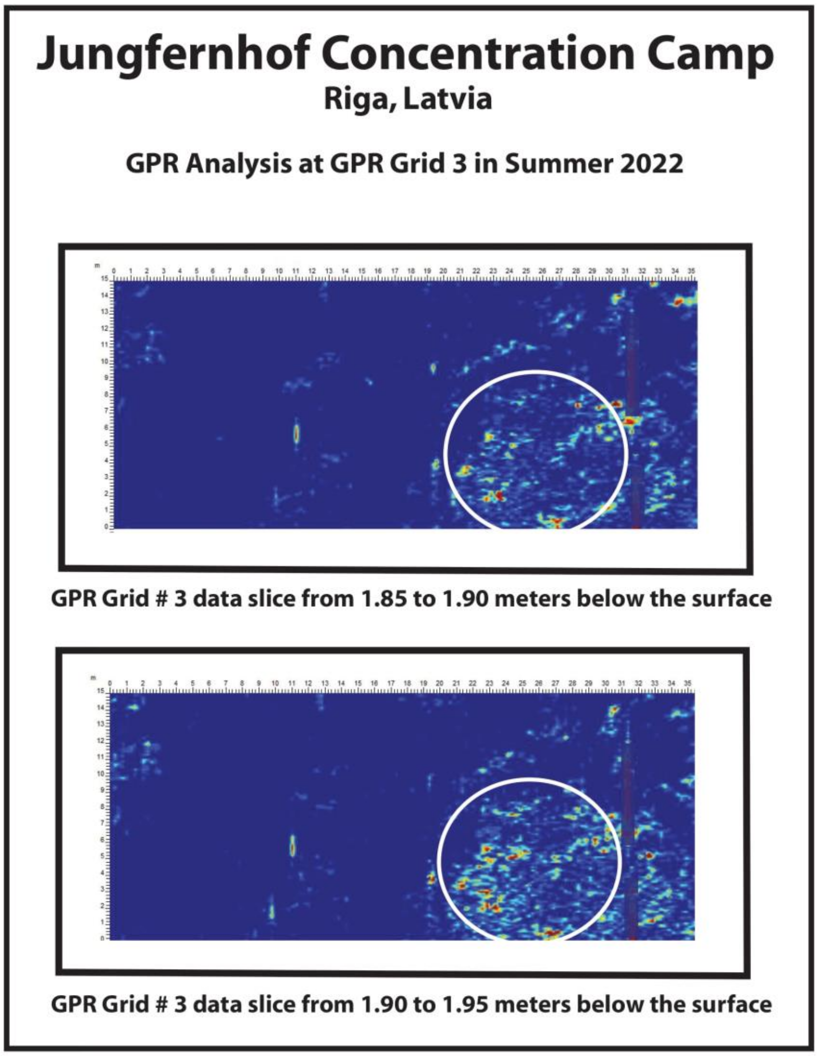



Figure 22 – GPR data slices from GPR Grid 3 (summer 2022), with an anomalous feature highlighted.

## Summary, Review, and Conclusions

Figure 23 summarizes the locations where research was completed in 2021 and 2022. Plotted on this particular version of the project base map, are the locations of the 12 buildings that appear on the 1917 air photo. Figures 11 through 15 in this report show various plots for the 1917 building locations, and also allow the comparison of these locations with maps of the Jungfernhof camp area in 1942 and 1947. In 1947, all of the buildings from the 1917 air photo still appear on the map, but many do not appear on the 1942 map. This prompted the rejection of the 1942 map as inaccurate and unusable for this research. Additionally, the 1947 map (figure 15) has five buildings present that are not on the 1917 air photo, indicating that they were built after 1917 and before 1947. Also, in the 1985 satellite image of the area, all of the buildings on the 1947 map are gone, with the exception of three ruined structures, one of which is the Mazjumprava Manor house.

ERT lines 1 and 2 were both analyzed in summer 2021. ERT line 1 had a sizable anomaly between approximately 65 and 75 meters along the line, and this anomaly coincides with an anomaly in GPR Grid 2, at the same location. This anomaly is interpreted to be the remains of a building that existed at the site in 1917 and 1947, but not in the first satellite image coverage of the area in 1985. There is an ERT resistivity and IP anomaly near the west end of ERT line 1, between 5 and 25 meters along this line. This anomalous feature is interpreted to be the site of a building that occupied this area of the site in 1917 and 1947, but similar to the other building that was formerly along ERT line 1, it is not present on the 1985 satellite image.

ERT line 2 interests both GPR Grid 1 and GPR Grid 3. An ERT anomaly exists along this line, between approximately 42 and 48 meters. Data collected from GPR Grid 3 did not detect this anomaly. It is postulated that the ERT anomaly is at a depth below the surface (2+ meters) to which the GPR signal can penetrate. GPR Grid 3 did detect a circular, anomalous feature beginning at a depth of approximately one meter. This anomaly is approximately 10 meters in diameter, and is still present in the data slice at 1.95 meters below the surface. Since the anomaly is still present at the deepest depth of penetration of the GPR signal, it is postulated that this feature continues to even greater depths. More research is required to further clarify if this feature is a burial pit.

GPR Grid 1 did not contain any anomalies, and the section of the ERT line that passes through this grid did not detect anomalous data. The data associated with this grid is interpreted to be over bank silt-size materials deposited during high discharge events on the Daugava River. These same materials blanket the land surface throughout the Jungfernhof Camp area, but in GPR Grid 2 (2021) and GPR Grid 3 (2022), what have been interpreted as anthropogenically-derived features, are found beneath these more recent deposits. As stated above, this is not the case with GPR Grid 1. Further investigation may be required to unequivocally state that certain areas of the camp contain anthropogenic features and to designate any of these features as burial pits/trenches.

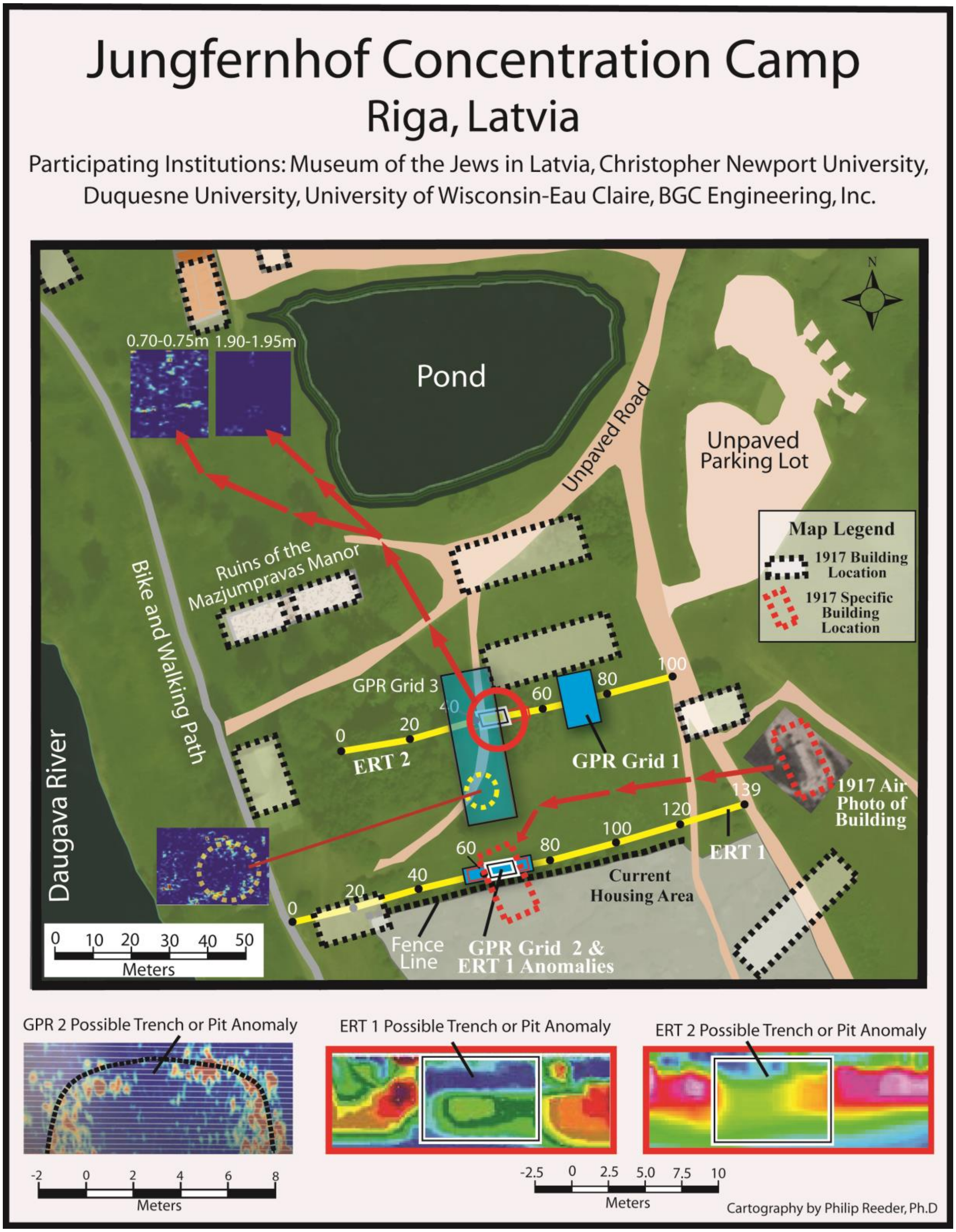



Figure 23 – Quintessential base map of the Jungfernhof Concentration Camp study site, with the 1917 buildings, ERT line 1 and 2, GPR Grid 1, 2 and 3 locations included, as well as a cut out of the specific building of interest, and the location and a slice(s) from GPR Grids 1 and 3 added.

In the research design section of this report, ten research questions were posed. Those questions are restated below, with answers to each question provided, which are based on the results and conclusions that were drawn based on the data collected for this project.

1. *Can target areas for the completion of Ground Penetrating Radar (GPR) data collection be established based on comparisons between a 1917 air photo of the Jungfernhof area, recent Google Earth satellite images of the area, and onsite reconnaissance?* GPR Grids 1, 2 and 3 were sited prior to accessing the 1917 air photo. Hence the locations for the placement of these grids was not influenced by the data eventually extracted from the 1917 air photo. There locations were influenced by the knowledge of the local area provided by Karen Frostig from the Lock(er) of Memory Project and Ilya Lensky, from the Museum of Jews in Latvia.

2. *Once the location(s) of the target area(s) is/are established, will GPR analysis of grids set up to coincide with the target area(s) indicate the presence of single or multiple data anomalies?* Anomalies were detected in the GPR data for two of the three grids. GPR Grid #1 did not possess any anomalies, and showed a data pattern, based upon interpretation, that indicates the deposition of over bank, silt-sized materials deposited during high discharge events (floods) associated with the Daugava River. There appeared to be no anthropogenic disturbances in the entire thickness of the collected data (down to 1.55 meters below the land surface). GPR Grid #2 detected a sizable anomaly. Based on the analysis of the 1917 air photo of the site, and a 1947 map, this anomaly was confirmed to be the remains of a building that once stood at the location. This assertion is further corroborated by the presence of a break (visual gap) in the data, which is interpreted to be the entryway into the building. GPR Grid #3 also contained a sizable anomaly. Located near the southwest corner of the grid, is a circular, 10-meter in diameter anomalous feature that begins to appear in the data slices for the grid at a depth just below one meter. The materials in the vicinity of this grid, and in reality for the entire Jungfernhof Camp area, are as previously noted silt-sized over bank deposits. The deposits from the land surface down to one-meter are from high discharge events that have occurred since the closure of the camp in 1942. Hence, any anthropogenic features that were at or near the land surface in 1942, are now buried under one-meter of material. Based upon the preliminary assessment and interpretation of this data, it is apparent that some type of human-created feature is present in this location, that extends from a depth of one meter below the surface to at lease 1.95 meters. It is too early in the data collection and analysis process to deem that this feature is a pit associated with the burial of Jews from the Jungfernhof Concentration Camp in the winter of 1941/1942.

3. *Can Electrical Resistivity Tomography (ERT) transects be established to better define subsurface features/anomalies at the site?* Two ERT transects (ERT 1 and ERT 2) were established at the site. ERT 1 was 139 meters in length and ERT

line 2 was 100 meters long. Both transects were oriented slightly south of east to west. ERT anomalies were present along both transects, with ERT line 1 possessing two anomalies (one near the beginning of the line near the Daugava River), and one in the central portion of the line centered near 67 meters on the line. ERT line 2 contained an anomaly centered at 42 meters along the line. The siting of the locations for these lines was influenced by the knowledge of the local area provided by Karen Frostig from the Lock(er) of Memory Project and Ilya Lensky, from the Museum of Jews in Latvia.

4. *If found, will the GPR and ERT anomalies both indicate features at the same location?* ERT line 1 traversed through GPR Grid 2. Both the ERT and GPR data indicated the presence of a strong anomaly in precisely the same location. By comparing the location to the 1917 air photo, and the 1947 map of the area, it was determined, unequivocally, that the anomalies indicate the presence of a building that stood at the location up until 1947, and most likely beyond this date. It is not known when this building was torn down. ERT line 2 also indicted a strong anomaly, but GPR did not indicate an anomaly at the same location. It is postulated that because the ERT anomaly begins at a depth below two-meters, the GPR did not pick up the anomaly because the GPR signal did not penetrate to this depth.

5. *Will GPR and ERT anomalies coincide with features from the 1917 air photograph and/or the 1942 or 1947 maps?* As already noted, the ERT line 1 anomaly that precisely matched the location of the GPR Grid 2 anomaly, was indicating the remains of a building that appeared on the 1917 air photo and the 1947 map. The 1942 map was not useable because of inherent inaccuracies associated with the map. This building was not present at this location in the 1985 satellite image. The 1917 air photo, and the 1947 map also show a building located near the Daugava River, that coincides with the beginning (near the zero point) of ERT 1 line. ERT indicated a resistivity anomaly, as well as an IP anomaly (indicating the presence of metal) at this location. These anomalies undoubtedly indicate the remains of the building that once stood at the location, that are now buried beneath the Daugava Rivers floodplain. This building does not appear in the 1985 satellite image; hence, it was removed some time between 1947 and 1985. Based on the analysis of the 1917 air photo and the 1947 map, no features on the air photo or map are correlated the ERT line 2, or the GPR Grid 3 anomalies.

6. *Will the hand-held lidar device "Geo-Slam" indicate the presence of subtle topographic variations that can be interpreted as an indicator of subsurface features?* A micro-topographic map of the Jungfernhof Concentration Camp site was created based upon data collected with the "GeoSlam" hand-held lidar device. A detailed assessment of this map did not indicate any micro or macro

topographic features that can be correlated with features in the subsurface that were indicated by ERT, GPR, or analysis of the 1917 air photo or the 1947 map.

7. *Will multispectral images collected using a drone indicate the presence of features on the land surface that coincide with features indicated by the "GeoSlam?"* Data collected from a drone was used to create a visual base map of the Jungfernhof Concentration Camp area. Similar to the base map created using the "GeoSlam," the drone map did not provide any details related to subsurface features that possess surface expression.

8. *If present, will these features coincide with ERT and/or GPR anomalies?* No surface features were indicated in the maps created from drone and "GeoSlam" data, hence nothing could be correlated with the ERT and GPR anomalies.

9. *Will the comparison of the 1917 air photograph, and maps of the site from 1942 and 1947 indicate similarities and/or differences in the presence of buildings at the site?* Definitely, yes. As previously indicated, the 1942 map was determined to be inaccurate and was not used. Based on the 1917 air photo, 12 buildings were present at the eventual site of the Jungfernhof Concentration Camp. In 1947, these same 12 buildings were present, along with five additional buildings/structures. By 1985, when the first satellite image of this area appears on the Google Earth website, all of these structures are gone. The Mazjumprava Manor house is in ruins, and there are also the ruined remains of a structure just south of the manor house by the Daugava River, and to the north of the ruined manor house, near the present-day pond located at the site. The manor house still remains as ruins. At the ruins north of the manor house, a building was constructed in 2018 on the footprint of these ruins. Also, in 2016 a structure was built on the footprint of the ruins south of the manor house.

10. *Will the data collected in summer 2021 and 2022 provide the impetus for the completion of additional research in the area in summer 2023, to further clarify the existence and characteristics of features detected in the 2021 and 2022 data sets?* A precise answer for this question is still being formulated. Many important discoveries were made based on the 2021 and 2022 data sets. There is still much more processing and analysis of this data that needs to occur. This work will continue. Are there continuing and new avenues for research at the Jungfernhof Concentration Camp site? Possibly yes, based on new or reformulated research questions that need to be answered. This point is addressed further in the "Proposed Research for Summer 2023 in the Vicinity of the Jungfernhof Concentration Camp" section of this report.

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**Proposed Research for Summer 2023 in the Vicinity of the Jungfernhof Concentration Camp**

Based on the fact that important discoveries were made at the site of the Jungfernhof Concentration Camp, the possible return to the site is being considered for summer 2023. Figure 24 summarizes the locations where GPR data was collected in summer 2021 and summer 2022, and posits the locations for three possible new GPR grids, wherein data may be collected in summer 2023. As presented in this report, we believe we have discovered important information about the site in general, and specifically about the three GRP grids and two ERT lines that were analyzed. We now know that the GPR Grid 2/ERT line 1 anomaly, located near the middle of the ERT line, is the remains of a building that once occupied that location at the site. Further, the resistivity/IP ERT anomaly near the Daugava River along ERT line 1 is the remains of a building that once occupied that location. GPR Grid 3, also possesses a location that requires additional investigation before a final determination can be made regarding its final characteristics, significance, and purpose. We are therefore considering a possible return to the site in summer 2023 (exact dates to be decided) for 2 to 4 days of addition research.

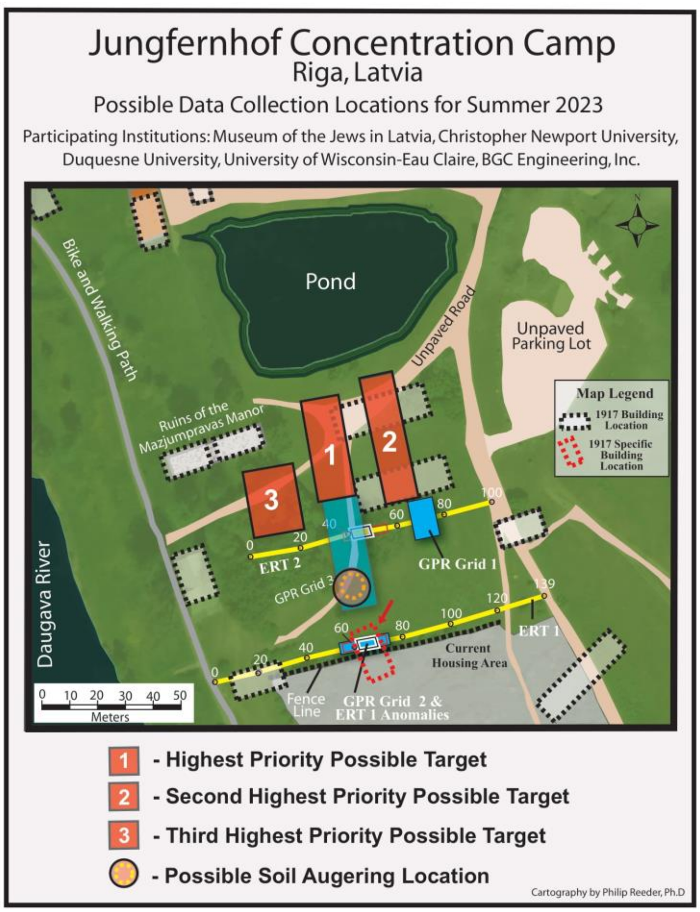


Figure 24 - Summary of research targets from 2021 and 2022, and possible new targets for summer 2023.

The possible grids for 2023 are ranked, 1 through 3. During the proposed possible two to four days on site, it is within the realm of possibility that all three locations can be analyzed using GPR. If this research moves forward, and we are indeed on site for two to four days, the assembled research group will begin with proposed grid 1 and complete as many grids as possible over the time on site.

In addition to possibly completing the GPR data collection at the proposed grids in figure 24, we propose to complete soil auger surveys at the location where the 10-meter diameter circular anomaly exists in the southwest quadrant of GPR Grid 3 (from 2022). This will entail going back to this anomaly, and using a soil auger (which is a portable hand-held device that allows samples to be collected beneath the surface without digging a hole), samples will be collected at the depths indicated in the GPR slices to coincide with the anomaly (approximately from 1.0 meters below the surface to an estimated total depth of 2.5 meters). This same technique will be used at any anomalies discovered in the three GPR Grids proposed for summer 2023. Samples will be transported to the research laboratories at Duquesne University, in the United States, for analysis. They will be analyzed for total phosphorus, which is a chemical indicator that human remains may be in the area where the sample was collected. Additionally, if any bone material is collected as part of this process, they will be evaluated for structure and type, and DNA analysis will be performed to determine sex, ethnicity, and similarities and differences between the collected bones/fragments, thus indicating the number of separate individuals the bone/fragment samples represent.

The 2023 phase of this research will answer the following possible research questions:

1. Are there GPR anomalies located in any of the proposed/tested 2023 GPR grids?
2. What is the nature of these anomalies in terms of length, width, depth and orientation?
3. How are these anomalies related to those discovered in grids 1 and 2 in 2021, and Grid 3 in 2022?
4. Will the analysis of soils collected using auger surveys at the circular anomaly from GPR Grid 3 from 2022 indicate elevated phosphorous levels?
5. Will the analysis of soils collected using auger surveys at any grid locations discovered in summer 2023 possess anomalies that indicate elevated phosphorous levels?
6. Will any bone material be recovered from the circular anomaly in the southwest quadrant of GPR Grid 3 from 2022, or from grids that contain anomalies discovered in summer 2023?
7. Using DNA analysis, can the sex and ethnicity of the individuals associated with the bones be determined?
8. How many different individuals are related to the bones?

By using methodologies similar to summer 2021 and 2022, new GPR anomalies may be discovered in 2023. By collecting soil samples, bone material may be discovered as well.

Analyzing the collected soils, and any bone material, will provide new evidence linked to the atrocities that occurred at the Jungfernhof Concentration Camp.

We are currently contemplating a return trip to Jungfernhof in summer 2023. Many factors weigh into this decision, which include funding, timing, need and our prioritized list of other commitments. A decision will be rendered no later than mid-February 2023.