KRZEMIONKI
PREHISTORIC STRIPED FLINT MINING REGION
WORLD HERITAGE NOMINATION POLAND
KRZEMIONKI
PREHISTORIC
STRIPED FLINT
MINING REGION

WORLD HERITAGE LIST NOMINATION
POLAND

January 2018
The Government of the Republic of Poland, acting in the belief that the Krzemionki prehistoric striped flint mining region constitutes a site of great importance for the heritage of the world, presents the application for the inclusion of the said property on the World Heritage List.

The Republic of Poland has been a party to the UNESCO World Heritage Convention since 1976. As with any international treaties ratified by the Polish Government, the Convention remains a source of universally binding law. The obligation to comply with the Convention applies both to all public administration bodies and to all Polish citizens. For more than 40 years, the Republic of Poland has afforded protection to World Heritage sites, mindful of the fact that by protecting our heritage, we also make a contribution towards our future.

The World Heritage Convention imposes upon us the obligation to protect and conserve sites which form part of the common heritage of humanity, to make such sites available to the public and to preserve them for future generations. This obligation has certain unique characteristics: it provides that any state which remains a party to the Convention shall have the privilege to designate sites of outstanding value and universal significance for heritage of the world as well as the obligation to protect such sites for the benefit of both present and future generations. Inclusion on the World Heritage List serves to reaffirm the unique value of the given site and reinforces the obligation to preserve it for all times.

The Krzemionki prehistoric striped flint mining region constitutes a site of great importance from the point of view of history, art and science. It is comprised of four component parts: the principal Krzemionki Opatowskie Mining Field; two smaller mining fields, Borownia and Koryczna, aligned on the same geological structure; and the Gwronicz prehistoric miners’ permanent settlement that received rough axes from the mines for finishing and polishing prior to distribution in a verifiable radius of 650 km from the complex, all dating from 3,900 BCE to 1,600 BCE. Underground structures together with a remarkably intact anthropogenic surface present a rare prehistoric industrial landscape - a clear testimony to the organisation of a prehistoric community based around mining.

The Krzemionki prehistoric striped flint mining region is, for a number of reasons, an outstanding site that deserves a universal recognition.
Cultural property of exceptional significance should be preserved as an element of World Heritage. The protection of World Heritage was widely discussed four decades ago bearing in mind how important our identity is in reference to all nations of the world. The issue of World Heritage protection is now gaining new importance in the context of a common European cultural space.

The abundance of cultural heritage sites in the Świętokrzyskie Province constitutes a decisive ingredient of the cultural identity among the region’s inhabitants; and further creates an opportunity of using this asset to promote the socio-economic development of the region and its touristic qualities. A special role is played here by unique sites of European and world significance – and recognition – of which Krzemionki undoubtedly exemplifies.

Krzemionki – Neolithic flint mines located near Ostrowiec Świętokrzyski – were recognized as a Monument of History by President of Poland on 8th September 1994 due to the exceptional condition of the preserved excavations as well as the results of long lasting archaeological research which revealed numerous secrets of prehistory, including the unparalleled highly advanced methods of flint exploitation.

The mining pits – remains of the Neolithic striped flint mines – were discovered by a geologist Jan Samsonowicz in 1922. During many years of research, the remains of approximately four thousand shafts and mining excavations have been discovered. They were carved in limestone by miners of the Neolithic Period and the early Bronze Age. It has been established that the mines were exploited from around 3900 BCE to 1600 BCE, hence they are now considered to be not only one of the biggest but also the longest functioning prehistoric mines in Europe. The striped flint which was excavated there was used to produce tools and ornaments. The mines are an excellent example of the development of prehistoric technical and creative thought and they constitute rare and great assets for further scientific studies. The Neolithic flint mines Krzemionki stand out clearly from other properties of a similar kind due to their size, cognitive qualities as well as to the scope and character of the archaeological research carried out and innovative conservational solutions applied.

Further, exceptional accessibility and durability, together with a fully resourced visitor infrastructure, enables their continued leading role in the development of learning and awareness of this crucial chapter in world history. The Krzemionki reserve is an unusually interesting tourist and didactic site. The visitor experience includes a museum and a guided underground route that reveals the unique architecture of prehistoric excavations that represent palpable workplaces of 5,000 years ago. On the surface, visitors can observe an exceptionally well-preserved landscape with numerous places of flint pre-treatment, miners’ camps, as well as relic xerothermic vegetation.

The Government of the Świętokrzyskie Province has been supporting the efforts of the Historical and Archaeological Museum in Ostrowiec Świętokrzyski towards making the “Krzemionki” mines a UNESCO designated site. We believe that on the basis of the abovementioned arguments, “Krzemionki” – as the first site in the Świętokrzyskie Province – deserves this great honour and recognition.

Adam Jarubas
Świętokrzyskie Province Marshall
In prehistoric times, in the area of today’s Ostrowiec District, specialised colonisation developed around a cluster of unique striped flint mines. The flint was excavated from Mesozoic limestone and used to produce polished axes, chisels as well as other tools and ornaments. Settlements were established mainly in the fertile Sandomierska Upland, several kilometres from the mines. For over two thousand years the most representative area of mining and manufacturing activity in prehistoric Europe existed and operated here. Its miners and manufacturers of flint tools have left a few thousand mines and an enormous number of flint tools distributed among communities within about a 650km radius, in the area of today's Germany, Czech Republic, Slovakia, western Ukraine, Belarus and Lithuania.

The unaltered form of underground mining structures such as shafts, drifts, chambers and corridors, as well as the landscape on the surface of the mines which have endured in Krzemionki, Borownia and Korycizna prove prehistoric man’s extraordinary knowledge of the environment, advanced technology and creative skills. It is an outstanding example, unique worldwide, of prehistoric mining technological relics and raw material treatment.

The government of the Ostrowiec District, conscious of possessing such a valuable site of cultural heritage in its premises, has been supporting the long-lasting efforts of the Historical and Archaeological Museum in Ostrowiec Świętokrzyski to register the Krzemionki Neolithic flint mines in the UNESCO World Heritage List. We realise that a site of such universal cultural value has to demonstrate an appropriate level of protection, accessibility and management at an appropriate level of financing. Therefore, in 2011–2012 we built a complex of buildings and facilities allowing the effective support of increasing numbers of visitors, together with scientific work in the Museum. Within the next two years, we are planning to take further actions to secure appropriate protection of the site and its accessibility, especially for the less-abled.

I am convinced that the cooperation between the Museum, the local government, the local community, and the National Heritage Board of Poland will result in the worthy placement of the Krzemionki Neolithic flint mines in the World Heritage List.

Zbigniew Duda
Ostrowiec District Governor
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Executive Summary
State Party

Poland

State, Province or Region

Świętokrzyskie (Holy Cross) Voivodeship
Districts (Powiat) Ostrowiec Świętokrzyski and Opatów

Name of Property

Krzemionki prehistoric striped flint mining region

Geographical Coordinates to the Nearest Second

<table>
<thead>
<tr>
<th>Id</th>
<th>Name of the component part</th>
<th>Region(s) / district(s)</th>
<th>Latitude</th>
<th>Longitude</th>
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<tbody>
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<td>N 50.9225</td>
<td>E 21.5499</td>
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<tr>
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<td>N 50.9681</td>
<td>E 21.5024</td>
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<td>K2</td>
<td>Borownia Mining Field</td>
<td>Ostrowiec Świętokrzyski</td>
<td>N 50.9258</td>
<td>E 21.5636</td>
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<tr>
<td>K3</td>
<td>Koryczna Mining Field</td>
<td>Ostrowiec Świętokrzyski and Opatów</td>
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<td>E 21.6045</td>
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<td>Ostrowiec Świętokrzyski</td>
<td>N 50.8843</td>
<td>E 21.5289</td>
</tr>
</tbody>
</table>
Executive Summary
Textual Description of the Boundary(ies) of the Nominated Property

The Property is a serial nomination of four component parts that, together, represent a singular ensemble of the prehistoric exploitation of flint. It contains the best preserved, most technically diverse and complete prehistoric flint mining assemblage known. All elements necessary to express potential Outstanding Universal Value are included and the boundaries of the nominated Property have been drawn to constrain all principal attributes. Buffer zones have been delineated around each component part to identify a sufficient area within which development or other factors might have a negative impact that could otherwise be a threat to the potential World Heritage values of the property.

Criteria under which Property is Nominated

**Criterion (i)** represent a masterpiece of human creative genius;

**Criterion (iii)** bear a unique or at least exceptional testimony to a cultural tradition or to a civilisation which is living or which has disappeared;

**Criterion (iv)** is an outstanding example of a type of building, architectural or technological ensemble or landscape which illustrates (a) significant stage(s) in human history.
Draft Statement of Outstanding Universal Value

Brief synthesis

Krzemionki prehistoric striped flint mining region (in short: Krzemionki) is located in the north-eastern fringe of the Świętokrzyskie (Holy Cross) Mountains in central Poland on both sides of Kamienna River. It is a serial property comprised of four component parts: the principal Krzemionki Opatowskie Mining Field; two smaller mining fields, Borownia and Korycizna, aligned on the same geological structure; and the Gawroniec prehistoric miners’ permanent settlement that received rough axes from the mines for finishing and polishing prior to distribution. The property dates from 3,900 BCE to 1,600 BCE (Neolithic to Early Bronze Age) and is one of the largest known complexes of its type. It is also the most complete and wholly readable socio-technical system of prehistoric underground flint mining and processing known in the world, and illustrates the greatest range of prehistoric flint mining techniques known in a single property. Features include great chambers with a floor area of over 500 m² that are unknown from any other site. Moreover, a unique type of flint – striped flint banded in exceptional zebra-like patterns of alternating shades of grey – was mined and fashioned into axes and distributed in a verifiable radius of 650 km from the complex, in present-day Germany, Czech Republic, Moravia, Slovakia, western Ukraine, Belarus and Lithuania.

A diverse range of mine types are also identified with different surface expressions in a remarkably intact anthropogenic surface that presents a rare prehistoric industrial landscape of shaft depressions and up-cast waste, remnants of flint workshops, miners’ camps and communication routes. Gawroniec Settlement, integral to the functional integrity of the deposit management system, is clear testimony to the organisation of a prehistoric community based around mining.

Criterion (i): Krzemionki prehistoric striped flint mining region is an outstanding example of exceptional creative and technical ability, providing clear testimony to early human inventiveness, mining techniques and organisation. The network of mine shafts, galleries and chambers excavated in hard limestone illustrates the greatest range of prehistoric mining techniques evidenced in a single site. It is an exemplar of the prehistoric ‘mining phenomenon’ whereby a radically new principle of underground mining allowed large quantities of better quality flint to be exploited from deeply buried seams.

Criterion (iii): Krzemionki prehistoric striped flint mining region is illustrative of the living and working patterns of settled prehistoric communities that distinguish the Neolithic period from that which preceded it. It provides exceptional scientific and anthropological evidence that supports a complete physical testimony of a distinctive cultural tradition that has disappeared.
The value of the nominated Property, including the integral Gawroniec Settlement (also the region’s most significant prehistoric settlement), is further enhanced by the proven distribution of striped-flint axes that have been identified in a radius of over 650 kilometres from the complex – the greatest recorded range for prehistoric flint axes as significant indicators of prehistoric movement.

**Criterion (iv):** *Krzemionki prehistoric striped flint mining region* provides exceptional evidence that the prehistoric period, which brought flint mining to produce tools, was a watershed period in the history of humankind. Diverse underground prehistoric mining structures are present in the nominated Property – comprising open-pit, niche-gallery, gallery, room-and-pillar, and chamber mines – and primary workshops survive intact amongst well over 4,000 shafts and pits.

**Integrity**

*Krzemionki prehistoric striped flint mining region*, as a whole, comprises the best preserved, most technically diverse and complete prehistoric flint mining assemblage known. All elements necessary to express potential Outstanding Universal Value are included in the serial property that represents the exploitation of the only deposit of striped flint to be mined in prehistory. Principle features and attributes have been confirmed in detail using a combination of historic and recent archaeological research, including Airborne Laser Scanning that has accurately mapped the sites in 3D under forest cover. The permanent settlement site, on a promontory in open agricultural fields, was archaeologically excavated in the late-1940s and ‘50s and the boundary exceeds the archaeological site boundary that contains all known evidence of prehistoric settlement.

The site does not suffer from current adverse development or neglect.

**Authenticity**

*Krzemionki prehistoric striped flint mining region* is characterised by an exceptional level of authenticity, in all its attributes, expressed in elements that include: the well preserved form and structure of the underground such as shafts, chambers, communication galleries, transport corridors, supporting pillars or waste heaps of mining and processing, as well as the aboveground industrial landscape consisting of shaft depressions and up-cast waste, remnants of flint workshops, miners’ camps and communication routes. The majority of the mining fields are left unexcavated. At Krzemionki Opatowskie Mining Field, a small segment of the mining field has been excavated archaeologically and, after some conservation work, gives unparalleled access to workings with a diversity and combination of attributes that have remained almost unchanged for over 5,000 years. Attributes of Gawroniec Settlement are equally easily read in terms of location and setting, Form, and archaeological evidence that is tangible proof of organisation and process directly tied to the mining fields. Archaeological excavations were conducted between 1947 and 1961 and apart from extensive waste from flint processing, dateable evidence included pottery (large storage vessels, funnel-shaped
flasks and vases, ceramic pipes, and ceramic weaving spindles) and organic remains which were radiocarbon-dated to between 3,500 and 3,200 BCE. New, additional and higher resolution, radiocarbon dates for the mining fields are being compiled during 2017–2018.

Protection and management

The nominated Property is under full legal protection in its entirety. The management system for Krzemionki prehistoric striped flint mining region will be implemented by the ‘Krzemionki’ Archaeological Museum and Reserve (Muzeum Archeologiczne i Rezerwat „Krzemionki”), a local museum that is renowned in Poland and which takes a lead role in the management and protection of Krzemionki. Its organisational structure will be adapted and extended to the other three component parts in the series as part of a new property management plan process currently (2018) in development and which will be adopted in that year. Currently there are no recognisable threats or vulnerabilities to the preservation of the nominated Property for future generations.

Name and Contact Information of Official Local Institution/agency

Organisation:
Ośrodek ds. Światowego Dziedzictwa w Narodowym Instytucie Dziedzictwa
(Centre for World Heritage at the National Heritage Board of Poland)
Address: ul. Kopernika 36/40, 00-924, Warszawa, Poland
Tel: +48 22 826 02 39, 22 826 92 47
E-mail: unesco@nid.pl, info@nid.pl
Web address: www.zabytek.pl, www.swiatowedziedzictwo.nid.pl
1. Identification of the Property
1. Identification of the Property
1.a Country

Poland

1.b State, Province or Region

Świętokrzyskie (Holy Cross) Voivodeship
Districts (Powiat) Ostrowiec Świętokrzyski and Opatów

1.c Name of Property

Krzemionki prehistoric striped flint mining region

1.d Geographical Coordinates to the Nearest Second

<table>
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<th>Id</th>
<th>Name of the component part</th>
<th>Region(s) / district(s)</th>
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<th>Longitude</th>
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<td>Ostrowiec Świętokrzyski</td>
<td>N 50.9681</td>
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<td>K2</td>
<td>Borownia Mining Field</td>
<td>Ostrowiec Świętokrzyski</td>
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<td>K3</td>
<td>Koryczna Mining Field</td>
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<td>E 21.6045</td>
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<td>K4</td>
<td>Gawroniec Settlement</td>
<td>Ostrowiec Świętokrzyski</td>
<td>N 50.8843</td>
<td>E 21.5289</td>
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Identification of the Property

Poland
Krzemionki
Świętokrzyskie Voivodeship
1.e Maps and Plans, Showing the Boundaries of the Nominated Property and Buffer Zone

Maps showing the boundaries of the nominated Property and proposed buffer zone are placed at the end of the Section 1.

1.f Area of Nominated Property (ha) and Proposed Buffer Zone (ha)

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1. Identification of the Property

ALL COMPONENTS MAP

NOMINATED PROPERTY

PROPOSED BUFFER ZONE

KRZEMIONKI
Prehistoric Striped Flint Mining Region

K1 - KRZEMIONKI OPATOWSKIE MINING FIELD
K2 - BOROWNIA MINING FIELD
K3 - KORYCIZNA MINING FIELD
K4 - GAWRONIEC SETTLEMENT

Map scale = 1 : 30000 at A2 layout format
Base map: ISOK geoportal.gov.pl   by: NID World Heritage Unit   date: Oct-2017
1. Identification of the Property

KRZEMIONKI OPATOWSKIE MINING FIELD

NOMINATED PROPERTY

PROPOSED BUFFER ZONE

KRZEMIONKI
Prehistoric Striped Flint Mining Region

50° 58' 30" N
21° 32' 30" E

print map scale = 1 : 10000
at A2 layout format
base map: ISOK geoportal.gov.pl by NID World Heritage Unit
date: Oct-2017
KRZEMIONKI
Prehistoric Striped Flint Mining Region

- NOMINATED PROPERTY
- PROPOSED BUFFER ZONE

Map scale: 1:10000 at A3 layout format
Base map: ISOK geoportal.gov.pl by NID World Heritage Unit, date: Oct 2017
1. Identification of the Property

NOMINATED PROPERTY

PROPOSED BUFFER ZONE

KRZEMIONKI
Prehistoric Striped Flint Mining Region

Print map scale: 1 : 10000 at A2 layout format
Base map: ISOK geoportal.gov.pl   by: NID World Heritage Unit   date: Oct-2017

O 50°0'N
O 21°33'30"E

O 50°52'30"N
O 21°33'30"E

O 50°54'0"N
O 21°29'30"E

component 4

component no.
2. Description
2.a Description of Property and Significant Features

Introduction

*Krzemionki prehistoric striped flint mining region* is a serial Property located in the north-east part of the Kielce Upland in central Poland. Krzemionki Opatowskie Mining Field is located around 8 km northeast of Ostrowiec Świętokrzyski in the district of Ostrowiec Świętokrzyski, Świętokrzyskie Voivodeship; Borównia Mining Field is located around 5 km northeast of Ćmielów; Koryczna Mining Field is located around 6 km ENE of Ćmielów; and Gawroniec Settlement around 1 km ESE of the centre of Ćmielów. The mines are located in the northeast foreland of the Holy Cross (Świętokrzyskie) Mountains, within the same geological structure that outcrops along a lowland area associated with the fault-controlled valley of the Kamienna River, a left tributary of the Vistula River.

The Property covers a total area of 349.2 hectares and is a serial nomination comprised of four, comparatively closely spaced, component parts. Three are mining fields located along a linear limestone-flint basin (broadly one at each end and one in the middle, spanning a total distance of 11 kilometres). These are selected to represent the entirety of the striped flint outcrop (Magonie-Folwarczysko Syncline) uniquely exploited in prehistoric times, and comprise extraction units (mines), manufacturing units (flint workshops) and temporary camps. The fourth component part is a settlement that was integral to the mines and is located in the south: they all form a ‘T’ pattern whereby the top arm of the ‘T’ (11 kilometres long) is the flint outcrop and its mines, and the vertical stem of the ‘T’ (5.5 kilometres long) links the settlement with the central area of the outcrop via the Kamienna River valley (easier to traverse, and with constant fresh water supply). The settlement is strategically placed not only for site-specific qualities (defence/water/agriculture/climate) but for optimum distance to all striped flint mines.

The size of each component part varies, and the boundaries have been drawn to attain the highest level of functional integrity possible for each exploitation area, together with the entire area of the settlement.
The physical geography of the region is fundamental to understand the spatial relationship between the four component parts. The flint mining fields in the north are aligned in the linear Jurassic limestone outcrop that is generally dry, warm and bereft of streams or water bodies. The class of land cover comprises almost exclusively forest in these mining field ‘wastelands’, with surrounding agricultural land being rather poor as the Jurassic limestone bedrock is covered with only a thin and nutrient-lacking layer of sandy and sand-clay Pleistocene sediments. The soil morphology at Gawroniec Settlement, however, is completely different, located at northern edge of the rich and fertile loess of the Sandomierska Upland.

Both the Sandomierska Upland and the Kamienna River (a large tributary of the middle Vistula River) exert important historical influences in terms of topography, hydrology and soil morphology, whilst the river and its valley were likely used for communication and transport.

<table>
<thead>
<tr>
<th>Id</th>
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<th>District (powiat)</th>
<th>Gmina (commune)</th>
<th>Village/ town</th>
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<td>Ćmielów</td>
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<td>Ćmielów</td>
<td>Ćmielów</td>
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</tbody>
</table>
Figure 1. Geographical location of the nominated Property and its component parts within the geographical regions of Poland by J. Kondracki (Geografia regionalna Polski, 2002, Warszawa)

Serial Nomination and Relationship Between the Component Parts

A serial nomination is necessary to achieve optimum integrity of the entire scope of prehistoric striped flint exploitation, its maximum research potential and long-term protection.

Component parts are integral to the whole nominated Property: three represent mining fields that are located within (and unified by) the same geological deposit (Magonie-Folwarczysko Syncline), a 11-kilometre northwest to southeast trending linear limestone outcrop containing striped flint (see section 2b). The syncline contains all known striped flint mines that were worked by prehistoric communities during the Neolithic (New Stone Age), and the Bronze Age, before the successive metallic age of iron production. The main prehistoric settlement associated with the beginnings of striped flint mining is called Gawroniec (from the promontory of that name). Its location is typical for such a settlement: on a defensible promontory, next to a water source in small tributaries of the Kamienna River, and with fertile soil suitable for farming. The Kamienna River bisects the syncline (striped flint outcrop) from north to south before turning west where Gawroniec Settlement overlooks its wide valley plain. During prehistoric times Krzemionki Opatowskie Mining Field had scarce water sources: there were no streams and the water table was, and still is, located below the level of the deepest mines; an area of karstic depressions represented the principal temporary water source. The situation was similar for Korycizna Mining Field, but at Borownia Mining Field the Kamienna River is only 100 metres from the western extremity of the mining field and an area strongly suspected of temporary settlement. The soil in the area of the syncline was, and still is, sandy-clayey and stony, generally poor and commonly unsuitable for crops, but with some areas improved for cultivation. At Gawroniec Settlement, conversely, it is a rich and fertile loess, being situated on the northern edge of the large expanse of loess that characterises the Sandomierz Upland.

Classes of extraction features

Krzemionki Opatowskie Mining Field illustrates an exceptional high level of technical creativity, the greatest range of prehistoric flint mining extraction features known from a single site that evidence the most advanced range of Neolithic flint mining methods known.

Exploitation features can be broadly divided into flint extraction (system of working and deposit management; pits, shafts, galleries, chambers, back-filled waste and surface tips), processing (chipping floors/workshops), temporary camps, and transport. Such features at Krzemionki Opatowskie Mining Field show that prehistoric miners extracted flint in different locations using different methods at different times. The features illustrate the full range of mining technology and techniques, dependent upon the geological characteristics and depth of the deposit and reflected in the location, size and morphology of the evidence for extraction – both on surface and underground.
Flint extraction features can be broadly divided into:
Type 1. Opencast pits on surface (shallow pits up to 2 metres deep);
Type 2. Underground niche-gallery mines (shallow shafts that link to a basal system of radial short galleries (up to 1.5 metres);
Type 3. Shaft and gallery(ies);
Type 4. Underground pillar-chamber mines (deeper shafts that link to galleries and chambers supported by \textit{in situ} rock pillars);
Type 5. Underground chamber mines (deep shafts that link to large chambers).

The latter four are named for their distinctive underground morphology that illustrates characteristic types of extractive techniques that also demanded a variable degree of planning, waste management and the use of different and specially developed tools (see section 2b).

At Krzemionki Opatowskie Mining Field, type 1, 2 and 3 extractive features (pit and niche-gallery mines) together comprise almost 75 per cent of extraction volume, with chamber and pillar-chamber mines comprising around 25 per cent.

At Borownia Mining Field and Korycizna Mining Field, from surface surveying (including airborne laser scanning and a range of geophysical survey techniques at Borownia), mine types are likely to be predominantly niche-gallery and pillar-chamber mines, the overall depth of the flint layers thought to be a little shallower. Recent (2017) excavation of a shaft and adjacent tip at Borownia Mining Field revealed very coarse rocks of hard limestone, indicating the penetration at depth of hard limestone strata and suggesting the potential of surviving chambers.

**Component Parts Description**

The mining fields that comprise three out of the four component parts of the nominated Property are located in the same geological deposit and are thought to broadly similar in character of physical content; though different in terms of size and date/phases of mining.

Krzemionki Opatowskie, however, is the only one that has been extensively studied by excavation and that presently has underground access. Borownia and Korycizna, however, have been non-intrusively studied by airborne laser scanning and ground-based geophysical techniques.
Krzemionki Opatowskie Mining Field

Krzemionki Opatowskie Mining Field is the principal prehistoric striped flint-mining field in the nominated Property. It is responsible for an estimated over 90 per cent of striped flint output during the prehistoric era and is one of the two largest Neolithic flint mine complexes in the world. Krzemionki Opatowskie and the other mining fields in the nominated Property are the first prehistoric flint mines to be discovered and protected in Poland. Krzemionki Opatowskie is the most intensively researched and is also only one of four such sites in the world. Substantial controlled public underground and surface access is complemented by extensive underground access for researchers, together with a visitor centre, museum, conference and educational facilities.

The component part is entered from the Krzemionki Archaeological Museum and Reserve that is accessed off the road from Ostrowiec Świetokrzyski to Bałtów. It corresponds to the prehistoric mining field and the wider distribution of flint workshops and temporary camps, located between the villages of Sudół, Stoki Stare, Magonie and Ruda Kościelna. The area of the component part is 311.3 hectares, and the actual area of flint mining covers 78.5 hectares.
At Krzemionki Opatowskie Mining Field the different depths of the flint layers varies with the structurally controlled deposit, the flint being shallowest on the lateral outskirts of the syncline and becoming deeper towards the middle of the syncline. The syncline also gets shallower towards the southeast. The exploitation field is part parabolic in shape (an outcome of basin deposition and subsequent folding), with two unequal arms of a total length of approximately 4.5 kilometres and a width of approximately 20 metres by 200 metres and covers an area of approximately 78.5 hectares. Mine shafts were dug between 5 and 30 metres from one another, depending on the structural and engineering geology and the consequent technique of extraction. Their total number is estimated at over 4,000.

Shafts/mines in the Krzemionki Opatowskie Mining Field have a comparatively long history of a naming logic that is retained to the present. In the years 1947-1948, a contour plan of the Krzemionki Opatowskie Mining Field was made in the scale 1: 200 by Eng. R. Gizowski. The measurements covered most of the historic area, except the southern field section that had been damaged by agriculture. The shaft hollows received a continuous numbering on the contour plan, maintained to this day. The exceptions are excavated shafts, which have been numbered in the order in which archaeological research was conducted. These numbers are added to the existing ones on the plan by R. Gizowski. For example, the 7/610 mine is the seventh researched site in Krzemionki, numbered 610 on a contour plan.

Figure 3. Krzemionki Opatowskie Mining Field. Pie chart illustrating extraction volume share of mine types based on their extraction features (after Borkowski, 1995).
2. Description

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Figure 4. Krzemionki Opatowskie Mining Field. Depth of the flint layers is also controlled by the structural dip of the deposit that is steeper (30 degrees) in the northern limb than the southern limb (5 degrees). Lithology also changes as you descend the stratigraphical profile (after Borkowski, 1995).

Figure 5. Krzemionki Opatowskie Mining Field. Extraction techniques used by prehistoric miners were conditioned by, and dependent on, geological-engineering characteristics that improved with depth as lithology becomes more consolidated, less weathered, less fractured and harder and structurally stronger in terms of ‘stand-up’ competence. The techniques were simple when the flint occurred at and near the surface, and more complex when it occurred at increasing depths (after Borkowski, 1995).
2. Description

<table>
<thead>
<tr>
<th>Flint extraction type (mine type)</th>
<th>Maximum range of exploitation (metres)</th>
<th>Distance from the nearest shaft (metres)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pit mine</td>
<td>2 – 3</td>
<td>4 – 6</td>
</tr>
<tr>
<td>Niche-gallery mine</td>
<td>3 – 4.5</td>
<td>6 – 9</td>
</tr>
<tr>
<td>Pillar-chamber mine</td>
<td>4.5 – 8.0</td>
<td>9 – 13</td>
</tr>
<tr>
<td>Chamber mine</td>
<td>7 – 20</td>
<td>14 – 25</td>
</tr>
</tbody>
</table>

Extraction features are recorded and numbered according to the sequential inventory of excavated shafts (Shaft 1, 2, 3, 4 etc.) and sequential inventory of located pits, chambers etc. (e.g. 795, 796). A combination of excavated shaft and associated recorded chamber creates, for example, 4/606.

Figure 6. Krzemionki Opatowskie Mining Field. Different depth of the flint layers varies with the structurally controlled deposit: the deepest chamber mines are located on the internal side of the parabolic exploitation field. Different widths of the limbs of the parabola are caused by a shallow dip in the southern limb and a steeper dip in the northern limb. Two faults also dislocate the deposit, and this is discussed in more detail in section 2b (after Borkowski, 1995 and Bąbel, 2015).
Figure 7. Krzemionki Opatowskie Mining Field: interpretive reconstruction drawing of the mining field (author T. Piotrowski).
2. Description

2.1 Description of Property and Significant Features

(author K. Pęczalski)
1.1 Prehistoric underground

1.1.1 Prehistoric underground ‘chamber mines’

Chamber mines are the largest, deepest, and most technically advanced type of extraction feature in the Krzemionki Opatowskie Mining Field. They occur at depths up to 9 metres from surface (shafts are typically up to 3 metres in diameter), the distance to the outermost mine face is (exceptionally) up to 20 metres and their floor area can reach as much as between 400 and 500 square metres.

The chamber mines 4/606 and 7/610 (with chamber mines 615, 795, 804 and 806 being only minimally excavated) represent exceptional and impressive achievements of technology and planning for Neolithic times. So far as discoveries made to date, they are unique in Europe, and worldwide. They testify to extraordinary understanding, planning, technical skills and precision of advanced engineering solutions in the Neolithic.

Figure 8. Plan of Shaft 4/606 (after Żurowski, 1962) with directions of mining in red (annotated by Bąbel, 2015), that help to explain much of the detailed features discovered.
Figure 9. Krzemionki Opatowskie Mining Field. Chamber mine at bottom of shaft 4/606 (author J. Lech).
2. Description

Figure 10. Krzemionki Opatowskie Mining Field. Chamber mine 795: communication gallery and (right) characteristic waste management feature of back-filled mine rubble packed to the roof. The extraction of flint left large voids that served to dump waste limestone rubble instead of unproductively carrying it to surface. A communication gallery was left to access the working face and to transport mined flint back to the shaft and to surface (author J. T. Bąbel).

Figure 11. Krzemionki Opatowskie Mining Field. Chamber mine at bottom of shaft 615 (author J. T. Bąbel).
Shaft 4/606, over 6 metres deep, was excavated in 1959–61, together with one of three radial shaft galleries and the perimeter wall gallery. The system was first surveyed in 1961 and was 3D scanned in 2017 to support the World Heritage nomination process.
This chamber mine is available to archaeologists for special study. One, of three, radial shaft galleries and the entire perimeter wall gallery were excavated. All other backfill remains in situ.
2 Description

2.1 Description of Property and Significant Features

Figure 13. 3D scan, perspective view north, of Shaft 4/606 and its chamber mine, surface and underground, showing perimeter of chamber. The central black area represents Neolithic backfill of mined void (author GeoCartis).
2. Description

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Figure 14. 3D scan, sectional view, of Shaft 4/606 and its chamber mine underground. This shows the overall average 4-degree dip of the chamber (corresponding to the dip of the flint beds) in a south-easterly direction towards the central axis of the basin (adjacent chamber mines increase in depth in this direction and are included in the visitor route). Field of view approximately 20 metres from left to right (author GeoCartis).
1.1.2 Underground ‘pillar-chamber mines’

Complex pillar-chamber mines were excavated, reaching 5-6 m depth, with the galleries and chambers supported by pieces of intact rock, in which the work was carried out at a distance of 8 m from the main shaft.

Exceptional examples include those connected with shafts 1, 2 and 3 in the area of the Great Chambers, and to shaft 11.

Figure 15. Polygons network superimposed on a plan of pillar-chamber mines to indicate individual mining units (after Borkowski, 1995)
Figure 16. Krzemionki Opatowskie Mining Field. Pillar-chamber mine in the region of shafts 2 and 3, where rubble was removed by Zurowski’s expedition in 1953–54; a standard archaeological practice for that time (author K. Pęczalski).

Figure 17. Krzemionki Opatowskie Mining Field. Pillar-chamber mine with prehistoric drawing (so-called ‘orant’ or ‘Great Mother’) in charcoal on pillar near shaft number 2 (visible from the visitor route). A number of such singular drawings (never as a group) were found during excavations in the 1920s on the northern limb of the parabolic outcrop structure. They were destroyed by farmers extracting limestone on, then, their private land (author A. Łada).
2. Description

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Figure 18. Krzemionki Opatowskie Mining Field. Pillar-chamber mine in the area of shafts 1, 2 and 3 with carbon marks on the pillar thought to be from the scraping of pinewood torches that served as illumination for prehistoric miners (author K. Pęczalski).

Figure 19. Krzemionki Opatowskie Mining Field. Pillar-chamber mine in the area of shaft number 2 (author G. Ciżdziel).
1.1.3 Prehistoric underground shafts

Only a limited number of shafts have been excavated. The visitor route uses the 11 m deep ‘Zenon’ shaft (number 0) to descend, and Shaft 1 to ascend.

Specialists may now descend Shaft 4/606 by fixed ladder within a structurally reinforced shaft compartment protected by a surface pavilion. It enters the chamber mine slightly north of its centre.

![Figure 20. North – south section of Shaft 4/606. (after Zurowski’s field records, 1962, annotated by Bąbel, 2015). 1 – rock rubble (1–2 cm) mixed with earth, 2 – (1–3 cm) with earth, 3 – rock rubble (0.5–1 cm) with earth, rock rubble (2–5 cm), 6 – ground, 7– charcoal, 8 – chunks of limestone, 9 – black humus, 10 – brown clay, 11 – limestone wall.]

![Figure 21. Krzemionki Opatowskie Mining Field. Shaft number 4/606, with concrete stepped reinforcing rings inserted to create access to a relatively pristine chamber mine. Access, by ladder, is 5 metres deep (author B. Gamble).]
2. Description

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Figure 22. Shaft 4/606. Structural solution used to secure the shaft (after Bąbel, 2015).
1.1.4 Prehistoric underground communication galleries

Communication and transport galleries are well preserved in chamber and pillar-chamber mines. In chamber mine 4/606 three radial communication galleries from the shaft were left by Neolithic miners and traverse the back-filled chamber (after extraction of the bedded flint seam) to reach the perimeter wall gallery and working faces that reveal considerable information in terms of techniques and working methods (see section 2b).

Figure 23. Krzemionki Mining Exploitation Field. Chamber mine accessed via Shaft number 4/606. Plan and profiles of East Gallery, drawn by H. Łęgowiecka from Zurowski’s field records, appearing in Bąbel, 2015.
1.1.5 Prehistoric underground waste management features

Waste limestone spoil and rejected flint from the working face was deposited in previously exploited parts of the mine – according to a highly efficient system of waste management. It was also used to provide enduring props to roof structures – stacked hard limestone block walls to support specific points of unstable roof strata and bulk limestone rubble heaped to the roof elsewhere. Excess spoil from underground development and flint extraction, and from shaft-sinking, was either tipped around the shaft collar or down an adjacent abandoned shaft.
1.1.6 Prehistoric underground lighting features

Once away from the limited daylight in galleries and chambers, workings were lit by torches made from pine wood. In 2005, ten samples taken from wood torches discovered in the underground network were dated using the accelerator mass spectrometry (AMS) facility at Erlangen-Nurnberg University, Germany. Radiocarbon dates suggest two main phases of exploitation: 3500 to 3100 BCE and 3100 to 2900 BCE; and confirm previous radiocarbon dates obtained from other mine units in the complex.

Figure 26 and 27. Krzemionki Opatowskie Mining Field. Neolithic firebrand made from a Scots pine (Pinus silvestris) branch, found in 2003 in situ in mine 804 (author J. T. Bąbel).
1.1.7 Prehistoric underground evidence of fires

Traces of fires have been found at the bottom of shafts, or some distance from the shafts. Whilst theories of forced ventilation have been ventured, it could be that the fires were used in the large chamber mines as a continuous source of flame for torches. Other tentative explanations include ritualistic purposes that are believed to be commonplace in prehistoric mines.

Figure 28. Krzemionki Opatowskie, chamber mine 815. Traces of a fire, and multiple charcoal streaks resulting from the charred tip of a torch being scraped against the rock wall, probably to remove burnt wood and restore a brighter flame (author J. T. Bąbel).

Figure 29. Krzemionki Opatowskie. Traces of a fire discovered in 2003 buried in rubble backfill, chamber mine 815 (author J. T. Bąbel).
1.1.8 Prehistoric underground graffiti

Some walls in the extensive underground system contain isolated charcoal drawings or graffiti, presently interpreted as coded information or an expression of a magical system and symbolism related with the beliefs of the prehistoric population. In communities which did not have writing, symbolism and ritual was a transmitter of practical knowledge from one generation to the next.

Several pictographs were discovered when small-scale limestone quarrying breached mine shafts, galleries and chambers on the northern limb of the parabolic mining field; they were subsequently destroyed. There is every reason to expect other such charcoal markings survive in the back-filled underground chambers of the largely unexcavated mining fields.

![Figure 30](image)

Figure 30. Krzemionki Opatowskie Mining Field. Location of finds perhaps of a sacred or cult nature: a – single pillar chambers with drawings; b – graffiti on a pillar in mine 2 (see figure 32, below); c – road where a flint bucranium was found; d – place with what were termed in the 1930s underground ‘temples’ (after Bąbel, 2015).

No human skeletons have been found underground in Krzemionki Opatowskie Mining Field, but in the backfill of mine 2 fragments of a human long bone were found. Traces of miners’ food, or perhaps ritualistic deposits, have been encountered: the jawbone of a wild boar, horse teeth, and others.

![Figure 31](image)

Figure 31. (above) Krzemionki Opatowskie Mining Field. Pictographs in charcoal on pillars investigated by Stefan Krukowski in a complex of what he called ‘temples’ decorated with charcoal drawings. The chambers subsequently collapsed (author T. Rekwirowicz).

![Figure 32](image)

Figure 32. (left) Krzemionki Opatowskie Mining Field. Pictograph in charcoal on a pillar in pillar-chamber mine 2, adopted as the logo for the Krzemionki Archaeological Museum and Reserve (author K. Pęczalski).
1.1.9 Underground ‘niche-gallery mines’

Niche-gallery mines demonstrate more advanced methods than opencast-pit mines in which near-surface flint was readily extracted. Niche-gallery mines comprised a vertical shaft, from 2.5 to 4 metres deep, with niche-galleries dug in all directions at the bottom, typically around 2 m in length. They were sunk in relatively unconsolidated strata and waste tipped at surface was susceptible to weathering that considerably denudes their profile, making them difficult to detect. One niche-gallery mine, 6/668, has been excavated and presented to the public.

Figure 33. Krzemionki Opatowskie Mining Field. Plan of niche-gallery mine 8/669 (after Salaciński, 1988).
Figure 34. Krzemionki Opatowskie Mining Field (visitor route). View from above the single shaft of niche mine 6/668. This was archaeologically excavated in 1982–84, and an interpreter is shown for scale and demonstration of mining method. The niches, eight in number, extend radially from just above the base of the shaft, each to a distance of less than two metres (author K. Pęczalski).

Figure 35. Krzemionki Opatowskie Mining Field. Section (profile) of niche-gallery mine 6/668 (after Bąbel, 1986). 1 – forest humus, 2 and 3 – clay, 4 – earth and limestone rubble, 5 – clay and limestone dust, 6 and 7 – sand, 8 – loam, 9 – chunks/pieces of limestone, 10 – flints, 11 – traces of a fire.
1.2 Prehistoric ‘industrial landscape’

The Neolithic and Early Bronze Age anthropogenic surface, or ‘prehistoric industrial cultural landscape’, is unsurpassed by any prehistoric mines in the world in terms of authenticity, integrity and surviving diversity of features.

It contains shaft collars and tips of the five principal mine types (chamber, pillar-chamber, gallery, niche-gallery and pit). These vary in character in terms of the diameter of shafts, their spatial distribution in relation to the structural deposit, the size and morphology of tips (including geological characterisation of the tip material that has differing weathering resistance); processing chipping floors or flint ‘workshops’ (primary and secondary); temporary camps and other occupation evidence including tracks; and biodiversity that is strongly influenced by prehistoric mining.

1.2.1 Chamber mine shafts and tips

Shafts of chamber mines, of all exploitation classes, present the most apparent features at surface. Their hollows are typically 4 to 5 metres in diameter, with shaft centres separated from each other by at least 15 metres (up to 25 metres). Tips, comprised of harder limestone rubble from deeper in the shaft reduce the weathering tendency of rubble, clays and sands, from nearer surface, that are tipped first.

Figure 36. Krzemionki Opatowskie Mining Field. Chamber mines at surface. These are the hollows with the largest diameter, the greatest distance between centres, and are associated with the largest tips that have the greatest resistance to denudation (author B. Gamble).
2. Description

1.2.2 Pillar-chamber mine shafts and tips

Shafts of pillar-chamber mines are also readily apparent at surface. Their hollows are typically 3 m in diameter, with shaft centres separated from each other by at least 9 metres (up to around 13 metres). Tips, like the chamber mines are also comprised of harder limestone rubble from deeper in the shaft that reduces the weathering tendency of rubble, clays and sands, from nearer surface, that is tipped first.
2. Description
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1.2.3 Niche-gallery shafts, opencast pits and tips

Niche-gallery shafts are much less prominent in the surface topography. Being sunk and worked in nearer-surface unconsolidated sediments they were not only back-filled and would have been prone to collapse, but their tips will have additionally weathered extensively due to large clay and sand content.

Figure 39. Krzemionki Opatowskie Mining Field. Pillar-chamber mines: landscape of shaft hollows and tips of shaft sinking and mining debris (author B. Gamble).

Figure 40. Niche-gallery mine 6/668, trench VI/83 showing N-S cross-section. 1, 2 – forest humus, 3–4 – clay, 5 – loam, 6 – loamy sand, 7 sand, 8 – loamy sand, 9 – flints, 10 – limestone (after Bąbel, 2015).
Opencast ‘pit mines’ occur in impressively large numbers with a high density and intense concentration that creates a gently undulating topography. There are little in the way of tips to observe on the ground as the surface sandy clays with weathered limestone rubble have not only been pushed into abandoned pits by Neolithic miners but, if left, were easily eroded. They are closely spaced, an average of 4 metres apart, and represent the simplest method of opencast mining at surface in holes up to 2 m in depth. It was possibly the most common method of mining in the first period of the operation of mines and worked near-surface flint on the outside of the syncline and along the southeast extension of its limbs.

Their morphology and size is less apparent compared to their well-known underground counterparts. Waste rubble management, of predominantly clay and highly weathered unconsolidated sediments, consisted of back-filling adjacent and previously worked pits, leaving shallow depressions with little, if any, in the way of tips. Pit-mined waste of clay and other soft material, even if tipped, would be prone to rapid denudation and leave little trace in the topography today. They are, however, impressive when surveyed by LiDAR, especially when visually and technically stripped of forest cover and viewed in a large group.

![Figure 41. Transverse profile of an opencast pit mine/trench (Trench IV/80–82). 1, 2 – forest humus, 3 – sand/gravels, 4, 5 – sand, gravels and loam with limestone dust, 6 – fragmented limestone with sandy loam, 7 – chunks/fragmented limestone, 8 – flints, 9 – charcoal (after Bąbel, 2015).](image)

Whilst opencast pit mines are very common at Krzemionki Opatowskie Mining Field, and at Borownia Mining Field and Koryczna Mining Field, they are nonetheless rare at comparative sites such as Spiennes (on the World Heritage List) where ‘few are known… likely as a result of many years of farming, as well as amateur digging and looting in the second half of the 19th and first decades of the 20th century, considerable damage has been done to parts of the mine lying near the surface.’
1.2.4 Chipping floors/workshops

Not enough is known of these features, there only being some excavations undertaken many years ago, of which there is little published record but prolific finds deposited in museums. They are, however, numerous, and most are well-preserved, providing a rich resource for future investigation.

Figure 42. Distribution of flint 80–100 cm below surface; 1 – flints; 2 – stones; 3 – outline of shaft well (after Balcer, 1996).
Figure 43 and 44. Processing chipping floors (flint workshops), marked by ubiquitous striped flint fragments and flakes, are located around many of the shafts in each mining field. They represent the first stage of primary processing at surface (following selection of suitable flint underground), commonly into axe ‘rough-outs’ (author J. Lech).

1.2.5 Temporary camps

Temporary camps and other locations of occupation evidence (mostly from dated pottery concentrations) was noted by early archaeological investigations. The sites were concentrated around seasonally water-filled (drain-less) karstic dolines located a few hundred metres south of the extraction area along the southern limb. A number of these survive, but some of these were lost in post-World War II quarrying operations. Large scatters of striped flint debris occur at these sites, indicating working of material brought from the mining field. Future investigations will be made in this area, both to examine the karstic features in detail and to re-examine their surroundings for further evidence of temporary prehistoric miners’ camps.

Figure 45. Karstic doline, roughly circular and several metres across. Pictured in summer after a thunderstorm and heavy rain, the water will likely remain, and be added to, throughout winter and spring (author B. Gamble).
2 Borownia Mining Field

Borownia Mining Field is located some 7.25 kilometres down-strike (southeast) from Krzemionki Opatowskie Mining Field. The north-western limit of the mining field lies immediately to the east of the Kamienna River and its floodplain, separated by a steep ‘river cliff’ of 5 or 6 metres in height.

The boundary of the 3.7 hectare component part encloses the mining field that takes the form of a gently sloping linear belt (170 metres above sea level in the northwest and just over 180 metres above sea level in the southeast) that is around 30 metres wide and is longer in the southern segment (370 metres) than the northern segment (120 metres).

Currently, no underground workings at Borownia are accessible due to there never having been any excavations of shafts. However, geophysical surveys (ground-penetrating radar) between 2010 and 2013, combined with airborne laser scanning, have confirmed the likelihood of underground pillar-chamber mines similar to those at Krzemionki Opatowskie Mining Field.

The surface prehistoric mining landscape is exceptionally well preserved and excavation to obtain charcoal for carbon dating was conducted in 2017, giving dates 2300–1500 BCE.

Figure 46. Borownia Mining Field, showing mining field with two linear belts of shaft hollows (centre). Kamienna River (left).

2.1 Prehistoric underground

Although the underground environment at Borownia has not been excavated, Ground Penetrating Radar survey at Borownia was performed in 2010–2013 (Mieszkowski et al) and in 2011 by the private company Proton-Archeo for the Scientific Association of Polish Archaeologists (SNAP).

Results comprise a concentration of anomalies caused by prehistoric mine shafts, outlines of which are clearly visible not only in GPR images but also correlated on the surface as oval hollows surrounded by waste tips.

Striped flint consisting of two parallel layers (at roughly 6 m and 8 m depths) was exploited at Borownia, as confirmed by radiogram (similar to that at Krzemionki Opatowskie Mining Field). Above these layers, there was a group of anomalies generated by the mine shafts at 5–6 m depth. They are probably niche-gallery and pillar-chamber mines. Roofs of galleries and chambers are clearly visible on radiograms as contrasting diffraction hyperbolas.

Figure 47. Borownia Mining Field. The results of the Geo-radar survey of the Borownia exploitation field. Depiction of the underground voids (after Migal, 2011).
2.2 Surface ‘industrial landscape’

The surface prehistoric ‘industrial landscape’ at Borownia represents the most undisturbed of its type anywhere in the world.

Amongst the undulating landscape of shaft hollows and waste tips, bifacial axe roughouts that correspond to the Early Bronze Age of the Mierzanowice culture predominated in finds. Recent (2017) retrieval of charcoal has confirmed dates of 2300–1500 BCE. During excavation a hand-sized backed fake knife, dated to the Bronze Age (‘Zele’ type) was also discovered.

Figure 48. Borownia Mining Field. Linear southeast segment of the mining field in forest (higher left) and northwest segment of the mining field in forest (centre right). The close proximity of the Kamienna River (top right) in a valley of flat meadows is evident (after Migal, 2011).

Figure 49. Borownia Mining Field. Echogram indicating mine shafts and underground flint extraction (after Migal, 2011).
Figure 50. Borownia excavations (2017) revealing profile (author J. Lech).
2.2.1 Mine shafts and tips

An exceptionally well-preserved prehistoric ‘industrial landscape’ is preserved at Borownia in two wooded segments of the mining field. These are separated by a 110-metre-long section marked by a small road and a field. Groundwork and agricultural ploughing have evened out/erased surface evidence of any shafts, tips and chipping floors that may have been present. However, geophysical surveys (ground-penetrating radar, effective in this instance to a depth of 7 metres, and other geophysical techniques) have been conducted in this area and have revealed what was confidently interpreted as dipping flint veins and underground galleries. This confirms that the mining field was continuous. The evidence was presented by Boubaki et al, 2012.

Figure 51. Borownia Mining Field. Northwest segment showing shaft hollows of probable pillar-chamber mines (author J. Lech).
2.2.2 Processing chipping floors/workshops

There is clear evidence that at Borownia there are numerous chipping floors that survive, creating an integrated functional mosaic with mine shafts and tips. Recent archaeological excavation conducted to support the nomination process (to retrieve charcoal for radiocarbon dating: Lech, 2017) revealed the pristine preservation of a chipping floor close to a shaft. Artefacts recovered include hammer-stones, many hundreds of flint flakes, pieces and cores, fragments of axe roughouts and a hand-sized backed fake knife (‘Zele’ type) tentatively indicating Bronze Age activity.

![Figure 52](image.png)

Figure 52. Borownia Mining Field. Excavation (2017) revealing a chipping floor with hammerstones and rough flint product (author J. Lech).

2.2.3 Temporary camps and occupation evidence

An area of open agricultural field adjacent to the northwest extremity of the component part is included to adequately contain a suspected settlement site, immediately to the south of a narrow valley and indicated by intensive Bronze Age pottery scatter, flint and stone tools. Such a site would have had easy access to both the mines and the Kamienna River as a water source and transport corridor. The suspected site was not deforested until the end of the 18th century and not ploughed and cultivated until the 19th century.

Though recognised as a prehistoric flint mine in the 1920s the first archaeological excavations took place for the purposes of charcoal dating in 2017.
2. Description
2.a Description of Property and Significant Features

Figure 53. Prehistoric anthropogenic surface in the smaller, northwest and in the linear southeast segments, Borowna Mining Field. The Thiessen polygon method has been used to constrain individual mining units based on the central point of shafts. 192 shafts are recorded, but this total is increased by the area of additional shafts detected by geophysics (Budziszewski, Grużdź, Zapłata 2012).
Figure 54. Borownia Mining Field: interpretive reconstruction drawing of the mining field and adjacent settlement above the Kamienna River (author T. Piotrowski).

Figure 55. Borownia Mining Field. The linear mining field, marked by shaft hollows, as seen on an Airborne Laser Scanning relief model. The depression between, though devoid of surface relief of prehistoric mining, contains underground mining voids and features detected by geophysical survey (Budziszewski, Grużdź, Zapłata 2012).
3 Korycizna Mining Field

Korycizna Mining Field is located a further 2.5 kilometres down-strike from Borownia Mining Field. The boundary of the 1.7-hectare component part extends to around 600 metres long, varies in width (typically around 70 metres), and gently slopes southwest. It comprises a linear belt of an anthropogenic surface of pits and shafts with tips, set in forest.

![Korycizna Mining Field](http://www.mapy.zabytek.gov.pl/nid/)

**Figure 56.** Korycizna Mining Field. The mining field is clearly visible as a linear belt of concentrated shaft hollows and pits (centre).

**Figure 57.** Korycizna Mining Field. Echogram revealing mineshafts at Korycizna. The limestone rocks are not highly absorbing the EM waves in general. The mine shafts are in contrast usually filled with limestone debris, thus they emit strong reflections, i.e. anomalous zones are clearly defined on radiograms by a set of characteristic hyperbolas. They are due to significant contrast in electric properties of solid rock and air partially filling the structure, among others the voids in poorly compacted debris (after Migal, 2011).
3.1 Prehistoric underground

Although the underground environment at Korycizna has not been excavated, Ground Penetrating Radar survey was performed in 2010–2013.

This revealed a concentration of anomalies caused by prehistoric mine shafts, outlines of which are clearly visible not only in GPR images but also correlated on the surface as oval hollows surrounded by waste tips.

3.2 Surface ‘industrial landscape’

3.2.1 Mine shafts and tips

The mining field comprises a well-defined linear belt of concentrated prehistoric pits and shafts with their surrounding waste tips, set in forest.

3.2.2 Processing chipping floors/workshops

There is clear evidence that at Korycizna there are numerous chipping floors that survive, creating an integrated functional mosaic with mine shafts and tips.
4 Gawroniec Settlement

Gawroniec Settlement is located on Gawroniec Hill, an east-west trending promontory that is around 600 metres long and 240 metres wide around its centre (220 metres wide at the western end, and 110 metres wide at the eastern end). It gently rises from the east to the west to reach a maximum of 203 metres above sea level. It overlooks Ćmielów, around 170 metres above sea level, located in the Kamienna Valley to the south of the striped flint mining fields. It covers an area of eight hectares, experiences an especially warm microclimate and is occupied in the present day by arable fields. It is one of the most important Neolithic settlement sites in the region.

To the south, east and west, it is surrounded substantially by an open and undulating upland loess agricultural landscape with views to a ridgeline and road in the south (the northern margin of the Sandomierz Upland). To the north it overlooks the town of Ćmielów, a linear settlement that straddles road 755 along the WNW–ESE trending Kamienna River Valley.

The topography of the settlement and production site is typical for its time: defensible, good soils for farming, and next to fresh water in the steep ravine along the southern border (where a stream persists).

Figure 58. Gawroniec Settlement located on the distinctive promontory (centre).

4.1 Processing chipping floors/workshops

In terms of the functional integrity of technology, this settlement is where flint rough-outs were delivered from the mines and where axe heads were made and polished prior to distribution. Flint axes were central to the toolkit of the first farmers, essential for changing the landscape from woodland to farmland and for both light and heavy building work. Especially in chisel or wedge-like form they were also used at Krzemionki as miners’ tools. In terms of archaeological features recorded in the 1950s and ’60s (especially numerous pits containing prolific flint waste), it is useful to indicate what process was likely carried out at this site in the Neolithic period (aside from dwellings and farming). Rough-outs of close-grained striped flint were flaked to a thin profile and then smoothed and sharpened by grinding. Small axes, usually woodworking tools, were also made and some axes were highly polished possibly for aesthetic and symbolic reasons. The finished axe-head was sometimes set into an antler socket (which acted as a shock absorber) or hafted to a wooden handle and lashed in place with leather binding. For the axe-maker, the transformation from rough to polished was a practical process to remove flaws and fractures, shaping to make it suitable for different jobs (varying from thick wedges to thin sharp chisel forms) and also a ritual process to focus the supernatural properties of the stone. From archaeological evidence, this production process was almost certainly carried out here, the largest known settlement associated with Krzemionki prehistoric striped flint mining region (mines of the Magonie-Folwarczysko Syncline).

4.2 Settlement features

Gawroniec is by far the largest and the most important Funnel Beaker Culture settlement on the Sandomierz Upland (there are well over 500 known, with perhaps 50 of these perhaps belonging to the same community as Gawroniec). It was a miners’ commuting settlement and flint-knappers’ production settlement with set stylistic and technical standards for the production of flint tools.

Excavation revealed a differentiation of settlement features that relate to rational and organised functional group specialisation in flint processing to achieve production surpluses (probably the common property of the entire settlement community) for profitable barter/trade. Other settlement features relate to the storage of cereals and to the preparation of meat and bones.
Archaeological excavations between 1947 and 1961 measured 4,622 square metres. From features noted, pottery types recovered and 14C dating, the settlement is attributed to Neolithic Funnel Beaker communities that worked the striped flint mines and processed their output of flint nodules and chunks. This is therefore considered to be a settlement of miners, flint knappers and their families. It should also be noted that compared to other settlements in the region the best quality of ceramics were found, indicating possibly a better quality of life, an assertion perhaps supported by the common occurrence of the bones of young (as opposed to mostly older) domesticated animals.
Tens of thousands of flint artefacts were found in 16 pits in the north part of the settlement. They represent workshop assemblages generated by discarded refuse, a zone of flint workshops where specialised processing took place. Artefacts comprise not only chipping flakes resulting from axe manufacture (predominantly Krzemionki striped flint), but also initial forms and half-products of axes (slim, wedge-like, trapeze-like), mainly four-sided but also three-sided and (exceptionally) two-sided celts – tools that were essential for felling trees. 256 spherical and multi-faced hammer-stones were also found, as well as picks, perforators, groovers and borers – a typical range of stone tool types used in flint exploitation.

Due to erosion, no traces of ground-level buildings were discovered, but 328 pits were discovered in three distinct clusters (north, middle and south) and were interpreted as the underground level connected with over ground buildings.

Striped flint from the Krzemionki mining region (57 per cent of artefacts found) was mostly used to make axes, whilst white-spotted Świeciechów flint (43 per cent of artefacts found) was mostly used to make blades. 70 per cent of tools found were made from Świeciechów flint, and 30 per cent from striped flint. Funnel Beaker communities distributed striped flint in a radius of up to 280 kilometres from the site, and Świeciechów flint in a radius of up to 470 kilometres. This evidence points to an initial role played by Funnel Beaker communities in the exploitation of striped flint that continued into the Bronze Age.

### Ćmielów, Site I. The collection structure and numeric hierarchy of the Lesser Poland Industry FBC tools

<table>
<thead>
<tr>
<th>Tool group</th>
<th>Type, variant</th>
<th>l.o.</th>
<th>%</th>
<th>l.o.</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Retouched blades</td>
<td>of Category I</td>
<td>283</td>
<td>12.52</td>
<td>571</td>
<td>25.26</td>
</tr>
<tr>
<td></td>
<td>of Category II</td>
<td>288</td>
<td>12.74</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. End-scrapers</td>
<td>from blades</td>
<td>248</td>
<td>10.97</td>
<td>294</td>
<td>13.00</td>
</tr>
<tr>
<td></td>
<td>from flakes</td>
<td>46</td>
<td>2.03</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Other flake tools</td>
<td>Scrapers</td>
<td>71</td>
<td>3.14</td>
<td>550</td>
<td>24.33</td>
</tr>
<tr>
<td></td>
<td>Denticulated and notched tools</td>
<td>102</td>
<td>4.51</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bifacial tools</td>
<td>14</td>
<td>0.62</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Postretouched tools</td>
<td>363</td>
<td>16.06</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Hammer-stones</td>
<td></td>
<td>257</td>
<td>11.37</td>
<td>257</td>
<td>11.37</td>
</tr>
<tr>
<td>6. Axes, axes-like tools and picks</td>
<td>Core-type axes</td>
<td>110</td>
<td>4.87</td>
<td>145</td>
<td>6.42</td>
</tr>
<tr>
<td></td>
<td>Axes from blades and flakes</td>
<td>16</td>
<td>0.71</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Chisels</td>
<td>6</td>
<td>0.27</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Picks</td>
<td>13</td>
<td>0.58</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Perforators and blunt borers</td>
<td>Perforators</td>
<td>43</td>
<td>1.90</td>
<td>108</td>
<td>4.87</td>
</tr>
<tr>
<td></td>
<td>Groovers</td>
<td>39</td>
<td>1.73</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Blunt borers</td>
<td>28</td>
<td>1.27</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Other tools</td>
<td>Burins</td>
<td>9</td>
<td>0.40</td>
<td>61</td>
<td>2.66</td>
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<tr>
<td></td>
<td>Multiple tools</td>
<td>11</td>
<td>0.49</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Others and undetermined</td>
<td>41</td>
<td>1.78</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>2 260</td>
<td>100.00</td>
<td>2 260</td>
<td>100.00</td>
</tr>
</tbody>
</table>
2. Description

2.a Description of Property and Significant Features

Figure 61. Gawroniec Settlement: interpretive reconstruction drawing of the settlement (author: T. Piotrowski).
Setting of the Component Parts

The general character of the landscape and sites is rural. Krzemionki Opatowskie Mining Field, Borownia Mining Field, and Korycizna Mining Field are exclusively located in forested areas, which are also host to prehistoric chipping floors/workshops and temporary camps. They feel enclosed and have limited views into and out of the component parts. In contrast, Gawroniec Settlement, located on an open promontory, has expansive views out of the site but limited views to it. Specific settings are as follows:

Setting of Krzemionki Opatowskie Mining Field

The hummocky prehistoric mining terrain is set in mixed deciduous and evergreen forest (the mining field was covered with natural forest until 1914, gradually and partially deforested until 1922 when protection began in the form of a reserve, and has re-forested subsequently).

On the relatively flat denudation plain surrounding the Krzemionki Opatowskie Mining Field are: in the west – fields of open ground with little agriculture (mostly glacial till, with poor leached brown soils, much dune sand, clay and limestone rubble) and forest; in the north – arable fields in long narrow strips, and the N-S trending linear settlement of Magonie; in the east – continuation of arable fields in long narrow strips; and in the south – extensive forest.
Setting of Borownia Mining Field

The component part comprises pristine prehistoric industrial landscape located in two linear strips of forest (constraining the hummocky mining terrain that marks the linear outcrop), with the archaeological settlement site located in the arable fields to the immediate north. The setting comprises arable fields in the immediate north and south, extensive forest in the east, and the narrow Kamienna valley with its river and open meadows in the west.

Figure 63. View across open fields to the northeast sector of the Borownia Mining Field. Exceptionally well-preserved prehistoric industrial landscape occupies the forest, whilst under the field in the foreground underground workings have been detected using geophysical survey. The suspected settlement is located in an open field to the right (author B. Gamble).

Figure 64. Whilst outside the nominated Property, this is a typical view of the Kamienna River. The river and it’s valley are an important feature in the setting of the nominated Property.
Setting of Korycizna Mining Field

The hummocky terrain of the prehistoric mining field that exploits the linear outcrop is surrounded by forest in the north, south and west, with the eastern side opening to an abandoned quarry and open farmland.

Setting of Gawroniec Settlement

The nominated Property comprises a well-defined promontory devoted to arable fields which thrive due to good soil and a warm micro-climate. To the south and west, it is immediately surrounded by small dry ravines and valleys that rise steeply away from the Property to open and undulating upland agricultural landscape (there are views from the Property to a ridgeline and road in the south, the northern margin of the Sandomierz Upland). To the east the promontory drops steeply to the small road (Jastkowska 3487T), whilst to the north it overlooks the town of Ćmielów, a linear settlement that straddles the route 755 road along the WNW-ESE trending Kamienna River Valley.
Figure 66. Gawroniec Settlement. Farm track that crosses the promontory of open fields, from east to west (author B. Gamble).

Figure 67. Gawroniec Settlement. Steep scarp slope on the southern side of the Gawroniec promontory, above a narrow river valley (author B. Gamble).
2. Description
2.a Description of Property and Significant Features
2.b History and Development

‘Krzemionki is one of the few glorious memorials to the early childhood of modern civilization. Its importance reaches far beyond the borders of Poland. It is significant not only for the general history of culture and the history of mining, but also for architecture, the art of drawing, knowledge of past religions, and also for Polish sightseeing and international tourism.’

Stefan Krukowski, 1933.
Introduction

Krzemionki Opatowskie is, in technical terms, one of the most significant prehistoric mines in the world. As the principal source of striped flint output (over 90 per cent), it gives its name to the nominated Property that includes two further mining fields in the same deposit, together with a settlement site where flint was fashioned into axes.

Section 2. b describes the history and development of Krzemionki prehistoric striped flint mining region and, like section 2. a, necessarily focuses on the nominated Property and that related to proposed Outstanding Universal Value. It is structured with a general introduction, followed by the chronological development of the nominated Property with additional, extended and related, details (such as geological evolution and the archaeological discovery of Neolithic flint mines in Europe) that are organised by themes and presented in parallel.

The nominated Property comprises a series of prehistoric flint mines (in three mining fields exploiting the same outcrop) and their associated settlement: the principal Krzemionki Opatowskie Mining Field; two smaller mining fields, Borownia Mining Field and Koryczna Mining Field, aligned on the same geological structure; and a Neolithic miners’ settlement, Gawroniec Settlement, that received rough axes from the mines for finishing and polishing. These sites are described in section 2a.

The nominated Property represents the most complete and wholly readable socio-technical system of prehistoric underground flint mining and processing known in the world.

The period of large-scale striped flint mining at the nominated Property dates from 3,900 BCE to 1,600 BCE (Neolithic to Late Bronze Age). This is ascertained by a combination of radiocarbon dating of organic materials found in the mines, including charcoal and antler, and from artefacts recovered from the mines, workshops and settlements, typically pottery for which there are characteristics that identify distinct archaeological cultures.
2. Description

2.b History and Development

159 to 142 million years ago (Upper Jurassic)
Geological formation of limestone.

159 to 144 million years ago (Oxford)
Geological formation of striped flint.

Middle Neolithic to end of Bronze Age
Operation of striped flint mines in Krzemionki Mining Region.

4 million years to 2 million years BCE
Operation of striped flint mines in Krzemionki Mining Region.

2045
The entire area of Krzemionki Opatowskie Mining Field is excluded from the cultivation of crops.

The National Archaeological Museum (PAN) in Warsaw administers the area of Krzemionki Opatowskie Mining Field. The site is occupied by the German army and trenches are dug in three places.

1947-1961
Regional Monuments Inspector recognizes the area of the Neolithic flint mines as a monument and establishes a reserve.

1978
Archaeological excavations and investigations at Gawroniec Settlement.

1978
Prof. A. Tomaszewski. Permanent commission established to work on the protection of Krzemionki Opatowskie and its nomination for World Heritage listing.

1947-1952

1928 to 1932
Around 24 hectares of Krzemionki Opatowskie Mining Field are purchased, thus creating the rudiments of the archaeological reserve.

1929 to 1952 and 1968 to 1978
The National Archaeological Museum (PAN) in Warsaw administers the area of Krzemionki Opatowskie Mining Field. The site is occupied by the German army and trenches are dug in three places.

1945
The entire area of Krzemionki Opatowskie Mining Field is excluded from the cultivation of crops.

1945
Regional Monuments Inspector recognizes the area of the Neolithic flint mines as a monument and establishes a reserve.

1923
Archaeologists Stefan Krukowski and Zygmunt Schmit carry out the initial inventory of the mining field.

1929
Stefan Krukowski delineated the area of Krzemionki Opatowskie Mining Field, and ever since, the natural succession of forest has taken place.

1921
Stefan Krukowski characterizes striped flint for the first time, calling it "Astarcian flint".

1911 to 1914
Establishment of Krzemionki village, and soil cultivation damages some remains of flint processing workshops, and limestone quarries destroy some deep mines.

1925
The first professional excavation works take place in Krzemionki Opatowskie Mining Field when Józef Żurowski removes the rubble from seven shafts.

1922
Discovery of the Neolithic Krzemionki Opatowskie Mining Field by Jan Zamorski, a geologist and palaeontologist (Borownia and Korycizna Mining Fields also recognized as Neolithic flint mines).

159 to 154 million years ago Oxford
Geological formation of striped flint.

4th millennium to end 2nd millennium BCE (middle Neolithic to end of Bronze Age)
Operation of striped flint mines in Krzemionki Mining Region.

1927
Stefan Krukowski characterizes striped flint for the first time, calling it "Astarcian flint".

1922
Discovery of the Neolithic Krzemionki Opatowskie Mining Field by Jan Zamorski, a geologist and palaeontologist (Borownia and Korycizna Mining Fields also recognized as Neolithic flint mines).

1921
Stefan Krukowski characterizes striped flint for the first time, calling it "Astarcian flint".

1923
Archaeologists Stefan Krukowski and Zygmunt Schmit carry out the initial inventory of the mining field.

1945
Regional Monuments Inspector recognizes the area of the Neolithic flint mines as a monument and establishes a reserve.

2017
Archaeological excavation at Borownia Mining Field.

2011 to 2012
Construction of a new museum complex, artefact storage, conference facility, visitor centre and tourist information.

2004
Opening of a connected underground visitor route that includes several Neolithic mines and part of the underground limestone quarries called the ‘Great Chambers’.

1999
The boundaries of the Krzemionki archaeological reserve are determined by the Regional Monuments Inspector of the Świętokrzyskie Voivodeship.

1998–2002
Permanent Commission for the Conservator for the Krzemionki Opatowskie Archaeological Reserve prepared a programme of protection and activity connected with the Neolithic and Bronze Age monuments.

1999/2000
Responsibility for research at Krzemionki Opatowskie passed from the State Archaeological Museum, Warsaw, to the Regional Museum, Ostrowiec.

1994
The Neolithic mines in Krzemionki are recognised as a Monument of History by Order of the President of the Republic of Poland.

1991 to 1992
A reconstruction of a prehistoric settlement with reconstructed Neolithic houses and a moat and a parade ground is opened.

1990
The second visitor route is officially opened, an exhibition corridor cut into the rock to create a circular viewing tour of the prehistoric mines.

1985
An exhibition tunnel is officially opened in Krzemionki visitor mines, the world’s first tourist route presenting an underground part of a Neolithic mine to a broad audience.

1979
Krzemionki reserve is administratively passed from the State Archaeological Museum, Warsaw, to the Regional Museum (currently the Historical and Archaeological Museum) in Ostrowiec Świętokrzyski.

Start of new research programme conducted by the State Archaeological Museum, Warsaw.

1995
Krzemionki is recognised as a nature reserve, by Order of the Minister of Environment.

2002
Opening of a pavilion with an interpretive reconstruction of a flint-processing workshop.

2009
An interpretive exposition of a shallow niche mine is added, together with visitors’ bridges to provide an overlook of the anthropogenic surface of the mining field on the way to the shaft descent underground.

2010
Krzemionki is inscribed on the Polish Tentative List as the first stage of the nomination process to inscribe the Property on the UNESCO World Heritage List.

2000/2009
XXIst century
Overview of Geology and Geomorphology

Exotic striped flint, banded in varying shades of grey, formed in the late Jurassic, approximately between 159 and 154 million years ago (see section 2b). Deposits occur as nodules in weathered limestone rubble, sands and clays near the surface, and deeper in bedded discontinuous seams hosted in hard Jurassic limestone, a key attribute of the Property that has significant consequences upon technological values.

Prehistoric mining sites for striped flint are all located within the same geological basin: the Magonie-Folwarczysko Syncline. This common and specific geological locational factor, along with chronologically distinct socio-technical systems, binds the sites in a close relationship. The syncline is a northwest to southeast trending sedimentary basin manifested by a linear limestone outcrop that is 11 kilometres long (more detail on geology can be found in section 2b, History and Development). This outcrop constrains all known striped flint mines with exploitation dates from 3,600/3,500 BCE to 2,800 BCE in the Neolithic period and until around 1,800 BCE in the Bronze Age period. The nominated series represents the biggest, best-preserved and by far the most significant, and those with the highest integrity.

Lithology and geological structure, and the physical conditions under which flint occurred, strongly conditioned the type of deposit management adopted by Neolithic miners. Geology had a profound effect on the character and development of every aspect of mining activity, including the widest range of extraction tools known from any prehistoric mine, and the consequent size, morphology, distribution and other characteristics of the underground and surface primary extraction features that survive, unparalleled, today. Further, the unique mineralogy of the flint not only determined its application suited to the production of small and medium-sized axes, but to axes of an aesthetic (and perhaps symbolic) quality potentially unmatched in prehistory.

Mining took place from a relatively level plain; as opposed to hillside or valley terrain commonly encountered in other European Neolithic flint mines. Techniques were obviously relatively basic when flint was located close to the surface, consisting little more than digging opencast pits and shallow shafts with small niches cut from their base to follow the flint seam. In the case of flint that was buried under thicker strata, techniques were more challenging. Miners dug vertical access shafts up to nine metres deep to reach the shallow-dipping flint seams and large nodules. When these were reached, they followed them and extracted good quality nodular flint using sub-horizontal or gently sloping galleries and large complex chambers, with working faces extended to more than 12 metres from the shaft. This required lighting, and the development of new specialised tools because the limestone was hard and structurally competent at this depth. Aside from the difficulty of working such hard rock (Neolithic flint mines are commonly located in chalk), this allowed miners to plan the mining field (most Neolithic mines had some sort of ownership) and its exploitation sequence in the excavation of unique large chambers that also had the capacity for back-filled waste once flint was extracted. Another fortunate outcome of such conditions was the stable survival of these exceptional chambers. For working practices, see more detail in section 2b (History and Development).
First and foremost, the flint type was ‘striped’ or repeatedly banded in shades of grey, and occurred exclusively in Jurassic limestone. Secondly, the sub-horizontal flint layers (sometimes one, and sometimes two in number, one above the other) possessed a shallow dip that descended in limestone that varied in character in the vertical plane from surface.

A typical, but not universal, vertical geological profile in the area of chamber mines at Krzemionki Opatowskie Mining Field reveals the following materials at corresponding average depths (from geological survey and from surface materials, the situation may not vary too much at the other mining fields, except the flint layers might be present at shallower depth).

Shafts were sunk through overlying Pleistocene layers into limestone strata where the unique striped flint occurred in nodules and flattened concretions distributed in discontinuous layers that dipped towards the hinge of the syncline.

<table>
<thead>
<tr>
<th>Depth (metres)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Forest humus, white-yellow sand, weathered clay.</td>
</tr>
<tr>
<td></td>
<td>Loose clay-weathered limestone rubble (unconsolidated).</td>
</tr>
<tr>
<td>2</td>
<td>Loose pelitic limestone rubble-rock (fragmented and partially consolidated).</td>
</tr>
<tr>
<td></td>
<td>Cracked pelitic limestone (consolidated but partially weak).</td>
</tr>
<tr>
<td>6</td>
<td>Monolithic limestone with traces of marine organisms (consolidated, but less compact and more porous).</td>
</tr>
<tr>
<td>7</td>
<td>Oolitic limestone (predominantly un-cracked, softer but still structurally strong).</td>
</tr>
<tr>
<td>8</td>
<td>Layered pelitic limestone (predominantly un-cracked, hard and structurally strong).</td>
</tr>
<tr>
<td></td>
<td>Flint-bearing beds comprises two levels of nodules separated vertically from each other by 0.10 to 0.55 metres.</td>
</tr>
<tr>
<td>9</td>
<td>Lowest level of flint extracted by prehistoric miners.</td>
</tr>
</tbody>
</table>
The nature of the rock in the deeper horizons is unusual for flint mines: it is hard limestone – as opposed to the usual and softer common chalk of British and European Neolithic flint mines – and this increased in structural strength as the mines became deeper. Flint, composed of needle-like micro-crystals of silica, sponge spicules and micro-fauna is, of course, one of the hardest rocks known. Its use prevailed in prehistoric times, and Krzemionki flint is unique and with special consequences in prehistory. In addition to being strikingly beautiful with likely strong symbolic significance, its flaking and polishing attributes were ideally suited to axe-manufacture, even very small ones: such highly polished striped flint axes have been found, sometimes in twos and threes, in pan-regional grave goods.

In summary, geological engineering conditions in Krzemionki Opatowskie Mining Field prompted, within the monolithic layer, development of the largest, most sophisticated and technically advanced flint mines known from the Neolithic period, in the world. The desirability of ‘special’ striped flint to Neolithic communities was clearly so strong that they prospected and mined the deposit so intensely, over a considerable period of time, as to completely define its (parabolic) structure. Specific underground phenomena also consistently reflect, and strongly correlate with, a distinct range of primary mining features at surface.

Geomorphology and soil type also strongly influenced settlement, the easily defended promontory at Gawroniec Settlement possessing a rich cover of fertile loess.

Figure 69. The internal structure of Krzemionki striped flint differentiates it from any other flint type mined in the prehistoric world. The nominated Property contains the principal mines of the only such deposit mined in prehistory. Its nodules were fashioned into axes to cut trees; and might have also represented prized symbolic possessions due to its rarity, beauty and provenance from deep underground. Since the mid-twentieth century it has been found 30 km or so to the south, at Sandomierz on the Vistula River, from where cufflinks made from ornamental striped flint, set in silver, were official souvenirs of the Polish EU presidency in 2011 (author K. Pęczalski).
The geology of the nominated Property is associated with the northeast margin of the Holy Cross Mountains (Polish: Góry Świętokrzyskie). These were formed by mountain building events in the Silurian Period – specifically the Caledonian Orogeny – and subsequently rejuvenated in the Upper Carboniferous Period by the Hercynian Orogeny. They represent some of the oldest mountains in Europe.

In the Late Jurassic period of the Mesozoic era, the area of the contemporary Central Poland developed in the margins of the East European Craton and was part of the northern shelf of the Tethys Ocean. The present day northeast margin of the Holy Cross Mountains was situated in a proximal part of this shelf and late Jurassic Oxfordian (159–154 million years ago) sedimentation began with open shelf sponge-algal mudstones (Gutowski, 1998). Flint formed in a shallow warm sea and reef environment that ultimately became Jurassic limestone. This is unusual in comparison with most prehistoric flint mining that took place in Cretaceous Chalk, the lithostratigraphic unit encountered in the Neolithic flint mines of Britain and the wider northwest European chalk ‘province’ in which Spiennes (Belgium) and Rijckholt-St. Geertruid (the Netherlands) are situated.

Figure 70. Jurassic limestone exposed underground in a prehistoric chamber mine in Krzemionki Opatowskie Mining Field. Flint nodules sought by Neolithic miners occurred below this horizon of distinct sub-horizontal bedding, of variable thickness, with shallow dip. Fairly uniform bedding planes in competent rock assisted the driving of galleries and the creation of extraction chambers with uniquely large floor areas due to stable roof structures (author K. Kaptur).
Evidence for a large number of prehistoric mines (principally flint, and minor hematite) is located in Jurassic and Cretaceous limestone along the northeast margin of the Holy Cross Mountains. This forms a prehistoric mining region that has no equal. The total area of exploitation covers approximately 500 km$^2$, from Oronsko in the northwest to the Vistula River valley near Annopol in the southeast. Four distinct types of flint from this region have been classified by archaeologists: Chocolate, Ozarow, Swieciechow and, the most exotic of all, striped flint (also known as ‘banded flint’). Each flint type is best-suited to a different product: chocolate for points (arrowheads), Ozarow for bifacial sickle knives and striped flint for axes. The best-preserved underground prehistoric flint mines together with their surface counterparts, and the only prehistoric striped flint mines anywhere, are located in the southeast of this region.

**Striped flint**

Striped flint, with its unique attributes, is readily distinctive in terms of provenance, not only compared to other Holy Cross Mountain flints but, more widely in Europe, the common grey flint from the prehistoric mines of Spiennes (Belgium) and Rijckholt-St Geertruid (the Netherlands), and the black flints of the prehistoric mines of Grime’s Graves and the Sussex group (United Kingdom). Each flint type has different physical properties, that of striped flint is most remarkable for its irregular zebra-like pattern of alternating stripes of light grey, grey and dark grey. Theories vary, with iron content likely causing variation in colour, though with process not yet indisputable.

All flint likely formed by a similar geological process.

**Formation of flint**

The exact mode of flint formation is not scientifically clear. However, evidence suggests that it formed predominantly in the Jurassic and Cretaceous periods in shallow and warm marine environments. Compressed skeletal remains of sea creatures – including silica-rich sponge spicules – built up on the seafloor and were compressed and eventually turned from sediments into sedimentary rock (chalk and limestone). During this process of rock formation, known as diagenesis, discontinuous gelatinous masses of silica-rich material formed to ultimately create layered beds of flint nodules and sheet-like tabular masses.

The formation of striped flint occurred during the Oxford period of the Upper Jurassic, 159.4 to 154.1 million years ago. The climate subsequently changed, seas subsided, and erosion was followed during the last few million years by alternating glacial phases. The last glacial period was from around 110,000 to 11,700 years ago. It is popularly known as the Ice Age, and *Homo sapiens* spread from Africa into Eurasia (and Australia) near the end of this event.
Characteristics of Flint in the Krzemionki Prehistoric Striped Flint Mining Region

The in situ occurrence of flint can only be studied in one of the three mining fields (component parts) of the nominated Property: Krzemionki Opatowskie Mining Field; as the other two, Borownia and Korycizna, have not been archaeologically excavated.

Figure 71. Geological map showing Jurassic formations on the north-eastern slope of Świętokrzyskie mountains, drawn by geologist J. Samsonowicz. He discovered the Neolithic mines of Krzemionki during fieldwork 19 July 1922, in collaboration with archaeologist Stefan Krukowski, and was the first to describe them. This commenced the steady stream of scientific interest that continues today (after Samsonowicz, 1923).
Figure 72. Geological map 1934 covering the Krzemionki prehistoric striped flint mining region (after Samsonowicz, 1934).
Flint exploited from Krzemionki Opatowskie Mining Field in prehistoric times usually occurred in tabular concretions (strongly flattened, cake-like; so-called ‘płaskury’) of which the largest is around 10 centimetres thick, with a diameter of up to 2 metres and a surface area of several square metres. Cob-like nodules, from the size of that of a pigeon egg, are also common. There are two flint seams (beds or layers) that do not keep the same vertical distance from each other: they are separated by more than 2.5 metres at Krzemionki Opatowskie Mining Field in the northwest of the syncline, whereas in Zawichost on the Vistula River they are 80 centimetres apart (Budziszewski and Michniak, 1989). It is reasonable to assume that flint occurred in the other mining fields in the nominated Property in a similar physical form.
2. Description

Figure 74 and 75. Striped flint nodules in the prehistoric workings of Krzemionki Opatowskie Mining Field. Higher: exposed in situ in limestone. Lower: discarded nodule in underground mine spoil (author K. Pęczalski).

Figure 76. Tabular flint concretion, around one metre across, left by Neolithic miners at the low working face of a chamber in Jurassic limestone, Shaft 4/606, Krzemionki Opatowskie Mining Field. The flint was evidently of low quality, being finely but extensively cracked (author B. Gamble).
At Krzemionki Opatowskie Mining Field the flint seams occur at different depths in different parts of the mining field due to their dip in relation to the basin rocks of the Magonie-Folwarczysko Syncline.

![Sketch plan of the Krzemionki Opatowskie Mining Field, located at the northwest end of the Magonie-Folwarczysko Syncline (after Borkowski, 1995).](image)

**Key for schematic division into segments:**
- **A** — Area of explored underground pillar-chamber and chamber mines.
- **B<sub>1</sub>** — Knowledge gained from workings exposed by inter-war limestone quarrying.
- **B<sub>2</sub> + C** — Limited investigations.

**Figure 77.** Sketch plan of the Krzemionki Opatowskie Mining Field, located at the northwest end of the Magonie-Folwarczysko Syncline (after Borkowski, 1995).

It takes the form of an asymmetric parabola that dips most steeply in its northern limb. It is also geologically dislocated by three normal fault lines, indicated by the green arrows. Measured along the central axis, the length of the field is 4.15 kilometres, and from 20 to 200 metres wide. Around 4,000 pits and shafts penetrate this structure.
The Magonie-Folwarczyksky Syncline is one of several asymmetric folds running broadly from northwest to southeast, and is a tectonic deformation that originated as a result of the inversion of the Mid-Polish Trough during the late Cretaceous and early Palaeocene. The outcrop pattern of mining in the Borownia and Koryczna mining fields is linear, but as no underground archaeological excavation has yet taken place there is no information regarding the depth or dip of the flint beds. The size and spacing of shafts, however, together with geophysical research in recent years, suggests the possibility of deep underground mines (mines at varying depth) similar to those at Krzemionki Opatowskie Mining Field.

Figure 78. Typical striped flint nodule exposed in the modern visitor access level, Krzemionki Opatowskie Mining Field. Flint is confined to pelitic limestone in two discontinuous linear seams (author K. Pęczalski).
Flora and Fauna

‘Surface observations have been the basis for human knowledge about the core of the Earth for a long time... Sometimes plants and surface formations served as a guidance in mining exploration’

Krzysztof Kluk (1739–1796)

Landscape of Krzemionki

The area has an average annual rainfall of 625mm per year. The wettest month is July, also, it’s hottest, with an average 19°C. The coldest month is January, with an average -2°C, and there are frequent snows in winter. But today’s climate is not a model for that when the flint mines were in operation: then, spanning the entire Neolithic and Bronze Age, it was consistently warm and humid – almost until the third century BCE.

On the corrugated plain of Przedgórze Ilżeckie 250 000 years ago, on the Jurassic limestone formations, the glacier left deposits of sand and clay transported from Scandinavia. As a result of frost, wind and post-glacial processes rusty, permeable and non-carbonated soils were formed within the area of Krzemionki. Fast warming that occurred 10 000 years ago caused the development of plants and animals. In Świętokrzyskie Mountains and on Przedgórze Ilżeckie – tectonic foreland, warm and humid climate lasted almost until the end of 2 300 BP. At that time, multi-species deciduous forests with elm (Ulmus), lindens (Tilia), hazels (Corylus), oaks (Quercus) and ashes (Fraxinus) were dominating. At land depressions on marshes and peatbogs riparian and alder forests developed. There was large diversity of species. The climate was getting colder, which caused the extinction of thermophilic species of trees: linden (Tilia), oak (Quercus) and hazel (Corylus).

More than 5000 years ago, before the miners appeared, there was a mixed pine and oak forest – Serratulo-Pinetum was dominant. Currently the stand of the primary forest is made of oak (Quercus) and Scots pine (Pinus sylvestris) with silver birch (Betula pendula). Shrubs include: juniper (Juniperus), rowan (Sorbus aucuparia), alder buckthorn (Frangula alnus) and fir (Abies) and spruce (Picea) saplings. Ground flora include shrubs: European blueberry (Vaccinium myrtillus) and lingonberry (Vaccinium vitis-idaea), grasses and herbs. Rare paleorelic preserved within the area of Krzemionki since early post-glacial period is a rose daphne (Daphne cneorum). The terrain was made of karst depressions, erosion gullies and tectonic faults. On the dry flat area covered with woods, all of the depressions were distinguished by high humidity and characteristic hydrophyte plants. At the same time, near Krzemionki at Kamienna river, natural environment was very diversified. Loess hills were overgrown by multi-species deciduous forests. Warm slopes were covered by xerothermic swards. At the
low grounds there were meadows and peatbogs of variable moisture content. Numerous small ponds and marshes were overgrown by aquatic plants.

The landscape changes in the North-East surroundings of Świętokrzyskie Mountains within 12 000 years were ‘recorded’ by microfossils – the molluscs and pollen hidden in the soil.

The arrival of miners 5000 years ago and the long period of flint extraction have changed the natural environment of Krzemionki permanently.

Where did those miners, who had such a good knowledge of geology, plants and enormous mining knowledge, come from? What were the ‘signs’ in the middle of the pine and oak forest that directed the mining works that developed to such an extent? Many questions can be answered by the nature that used its own ‘code’, this code just needs to be read out. A strong connection of human with nature and the ‘landscape memory’ were the first pinpoint within the area. People were finding flint in rock outcrops on the buttresses at the rivers, in the pits, gorges, slips, overthrown trees and on the rock outcrops on the surface. Impact of Neolithic flint mining on natural environment is poorly discovered. Environmental studies of Krzemionki introduce new data for the Neolithic mining archaeology.

In Krzemionki, the environmental record of mining technology and technique can be found in shaft settlements and on the mines tips. Time ‘guides’ and ‘informers’ are the plans and molluscs preserved in the settlements and in the soil, occurring on the mining field nowadays.

**Environmental record of the mining technology**

5000 years ago in Krzemionki the flint was extracted in five types of mines: in pit mines or exploitation ditches, niche and niche-drift, drift, pillar-chamber and chamber ones. Shallow pit mines or exploitation ditches are located on the outer side of the mining fields, deep chamber mines are on the inner side of the field. After finished exploitation of the flint there were pit, niche and drift mines depressions left on the mining field, deep shafts of the pillar-chamber and chamber mines, in which periodically the precipitation water is lying. Also the mining waste tips can be found there.

Pit mines tips, according to Krukowski, were made of soil. They were built of forest humus, sand, calcareous loam with calcareous dust and limestone debris. Niche, niche-drift and drift mines tips were built of forest humus, fair and red clay, sand and limestone debris. While pillar-chamber and chamber mines tips were built of forest humus, fair and red clay, sand and loosely formed limestone debris.

As a result of flint exploitation the clay and limestone debris were thrown on the originally acidic and non-carbonated soils. Aluminosilicates contained in clay and carbonates washed away of the limestone, as well as increased humidity of the mining field fostered the development of plants and animals. On the mining field, the mosaic of 4000 mines with diversified soil and humidity conditions was created. Within the last 1500 years a new anthropogenic soil cover and microhabitats mosaic was formed. Shaft depressions were filled with debris humus rendzinas, tips were covered by brown rendzinas. A succession sequence of the South-Eastern
linden-oak-hornbeam forest – *Tilio-Carpinetum* formed at the mining field, as well as new complexes of fauna.

**Plants and molluscs as bioindicators**

The oldest human knowledge connected rocks with the vegetation. Indicator plants from the oldest times were the ‘guides’ of humans in settling, farming and mining. It has been proved that there is a close relationship between the type of geological substrate and the soil conditions, light, temperature, humidity, availability of calcium ions, acidity and organic matter content in the soil. Based on the gathered knowledge, indicator values for plants were introduced for Central Europe. For the conditions in Poland, indicator values were supplemented by Polish scientists. The use of palynological studies in archaeology were widely discussed.

Biological elements of high indicator significance are also molluscs (snails and clams). They are characterised by widespread occurrence, shell and particular sensitivity to such ecological factors as: light, temperature, humidity, pH and presence of calcium carbonate in the substrate. Molluscs are strongly connected with the type of geological substrate. Their shells, egg thecae, operculum and love dart are made of calcium carbonate. Characteristic complexes of snails occur in carbonate substrate, others on flint substrate. Snails consume algae and fungi that they scratch off the plants surface and of the rocks. They also eat leaves of some of the trees and herbs containing digestible calcium salts. The species preferred by...
the snails are: linden, maple, sycamore. They do not eat the leaves of oak, beech and conifers’ needles due to the tannins and indigestible oxalates content. Abundant complexes of snails can be found in humid deciduous forests, scarce – in dry pine woods. The species of snails connected with the old, decayed and rotting wood are the indicators for natural forests.

Main environmental factors deciding on the occurrence of snails are: humidity, presence of calcium carbonate in the substrate and light. The optimal level of acidity is pH 6.0–6.5. Molluscs and plants have similar requirements. Species rarely occurring at the border of geographical arrangement or remaining under the impact of human economy have higher requirements. They refer mainly to optimal humidity and availability of calcium ions. Division of molluscs into ecological groups was introduced by a malacologists Ložek. Based on the results of many of studies he created 12 ecological groups: E1 typically forest species, E2 undergrowth species, E3 inundated woods species, E4 steppe species, E5 meadow species, E6 dry habitats species, E7 mesophilic species, E8 higrophilous species, E9 hydrophilic species, E10 small, periodically drying out ponds, E11 ponds and lakes species, E12 rivers and creeks species. Molluscs, owing to their shells, are perfectly preserved in the settlements and in the soil. Similarly to plants, they constitute the record of the past, thus it is possible to perform reconstruction of the paleoclimate and type of paleo-habitat. The significance of molluscs in archaeology was widely documented.

Bioindicators are more sensitive than laser. They not only determine the archeological site location, they illustrate the process of changes of natural environment and define the direction of the changes. They are the environmental, cultural and technical information carriers.

The studies on snails within the area of Krzemionki reserve were carried out by the author in the years 1997 and 2009 using the standard quantitative Oeckland method (1930). The studies on malacofauna include 15 areas. Eleven of them are the mining micro-areas of different types of mines, two natural areas of the pine and oak forest outside the mining field and two areas of karst depressions outside the mining field. The soil, microclimat and snails in three types of mines were covered by the study.

Natural-mining units were singled out as follows: for pit mines, niche and drift mines and chamber mines. Technological micro-areas were singled out as follows: pits, shaft depressions and tips. The division refers to the depth of the mines, extraction technology and material stored on the tips.

The essence of the studies was the use of environmental sensitivity and indicator traits of snails and plants to determine ecological conditions of depressions and tips in different types of mines. The gist of the elaboration is the interaction of nature and technology, and determination of the impact of Neolithic mining on natural environment. Three main factors influence the occurrence of plants and snails on the mining field in Krzemionki: humidity, putting limestone debris and clay on primary soils. Modern malacofauna of Krzemionki was compared to the malacofauna occurring over the Kamienna river 5000 years ago. The comparison of nowadays snails occurring at the mining field in Krzemionki with quaternary snails occurring in the pits and shafts on the flint mining fields of Neolithic period – Grimes Graves and Cissbury in England also was performed. It was determined that the geological structure and flint extraction technology were decisive of the rate of succession of plants and malacofauna on the tips and mines depressions. Succession of plants and snails on the
tips of diverse lithology takes place with the participation of different species at a different pace. Other species occur on flint tips and others on the carbonate tips. Succession of snails on carbonate tips overtakes the succession on flint tips by more than 30 years. On the tips made of sand with addition of clay and insignificant use of limestone debris, it was faster than on the tips made mainly of limestone debris. Succession of plants and snails in shallow depressions of pit, niche and drift mines was faster than in shaft depressions. On the tips made of limestone debris there were extreme humidity and temperature conditions that delayed the succession of plants and snails. The meadow stage on high calcareous debris tips occurred only after approximately 60 years. In the early stages of plants and snails succession the species of open habitats occurred: meadow, steppe ones and species with high distribution. A pre-forest stadium on carbonate tips is formed for more than 200 years. In the pre-forest stadium the forest, undergrowth, meadow and humid habitats species occurred. After finishing of the extraction in Krzemionki, a mosaic of microhabitats of large biodiversity and extraordinary abundance of vascular plants (510 taxons) was formed. The number of the rarest species of plants is 42, and 27 taxons are legally protected.

The rarest plant species are: rose daphne (*Daphne cneorum*), ladybells (*Adenophora liliifolia*), orchids (*Cypripedium calceolus* and *Cephalanthera rubra*), dwarf cherry (*Cerasus fruticose*). The rare animal species here are beetles (*Osmoderma eremita*), mantis (*Mantis religiosa*),

![Figure 83. Cipripedium calceolus (author B. Sępioł).](image1)

![Figure 84. Lilium martagon (author B. Sępioł).](image2)

![Figure 85. Daphne cneorum (author B. Sępioł).](image3)

![Figure 86. Adenophora liliifolia (author B. Sępioł).](image4)
butterflies (Apatura Ilia, Iphiclides podalirius, Papilio Machaon) and snails (Chondrula tridens and Nesovitrea petronella).

A significant number of plant and malacofauna species arrived in Krzemionki along with the miners from the neighbouring areas, but also from very distant terrains. A Ponto-Caspian and Balkan steppe species is a land snail (Chondrula tridens) which arrived in Krzemionki with the miners. In Neolithic period the steppe species of plants and snails migrated to the North with the people using the steppe corridor running to the Black Sea. In Europe in Neolithic period herding, farming and settling-barrows, caused the drying of habitats and permanent reduction of biodiversity and significant depletion of malacofauna.

Five thousand years ago miners in Poland and Europe started irreversible ecological processes of succession and migration of species, running differently from those connected with herding, farming and settling.

Figure 87 and 88. Bioindicators are the carriers of environmental and cultural information, as well as information referring to the extraction and output storage technology. They provide information on natural recultivation of the early mining (after J. Barga-Więcławska, 2016 – diagrams presented at the exhibition Historic Mines. Art of nature, work of people, National Heritage Board of Poland).


History of Krzemionki Prehistoric Striped Flint Mining Region

The Neolithic ‘mining phenomenon’ used a radically new principle of underground mining that allowed large quantities of better quality flint to be exploited from deeply buried seams. The vast underground network and surface industrial landscape of pits and shafts at Krzemionki is the best exemplar of the application of such new inventive technology, and the organisation of extraction, production and distribution.

Mining activity at the Krzemionki prehistoric striped flint mining region began around the middle of the 4th millennium BCE. From around 4,300 BCE there is evidence for large-scale, organised, mining by the Funnel Beaker culture. For the first time in Europe, communities that represented this culture implemented the exploitation of mineral resources and the mass production of smoothed stone tools, extensive soil cultivation, and introduced new forms in the construction of dwellings. Funnel Beaker communities mined the striped flint deposit at Krzemionki and established the settlement on the Gawroniec hill (a component part of the Property), Ćmielów, where they fashioned axes and distributed them over a distance of more than 300 kilometres. Traces of their activity on the site are concentrated in different areas: production sites (flint processing for axes and blades, pottery and copper metallurgy) clearly separated from dwellings. Megalithic tombs, and other tombs with stone structures, though located away from this site, are also connected with this culture.

The most intensive mining phase at Krzemionki occurred around the second half of the fourth and first half of the third millennia BCE. This is not attributed to the Funnel Beaker culture but rather communities of the Globular Amphora culture. $^{14}$C dates indicate a range from 3,400 to 2,800 BCE. These communities bred cattle, pigs and horses, and the largest underground works at Krzemionki – the chamber mines – are attributed to them. During this period, not only did exploitation reach its most impressive level (output and technology) but so, too, did distribution: bifacial axe heads of polished striped-flint have been identified in a funerary context in a multi-directional radius of over 650 kilometres from the nominated Property, in present-day Germany, Czech Republic, Moravia, Slovakia, western Ukraine, Belarus and Lithuania. This represents the greatest recorded radius of distribution for Neolithic flint axes.

It is likely that specialised clans were dedicated to working in the mining fields and settlements: miners, with geological and technical skills and experience to be able to locate and exploit deposits effectively and safely, and also ‘dressers’ and flint tool manufacturers that were experienced in assessing, preparing and working the raw material. Apart from the demand for the production of tools, flint extraction was also of religious and symbolic significance. Unused, decorative and finely polished axe blades of striped flint may have been carried as talismans or symbols of gods, or given as burial gifts to warriors or other important people for their road to afterlife. It is also likely that highly polished miniature axes, a mere few centimetres long, were worn as amulets and symbols of deities.
Mining at Krzemionki was gradually abandoned around 1,600 BCE, a time that also marked the assumed transition between the Neolithic and Bronze Age in Poland, triggered by technical progress and the introduction of a new material for the production of tools (bronze), together with the associated disappearance of old beliefs. At this time, miners of the Mierzanowice culture exploited the deposit at Krzemionki Opatowskie Mining Field. Apart from the exploitation of shallow mines, they sought useable waste flint, digging up earlier tips and the widespread remains of flint workshops. Products made of striped flint were distributed up to 85 kilometres from the nominated Property.

Systematic archaeological investigation has been undertaken in the Krzemionki Opatowskie Mining Field, both on surface and underground, with the objective to map the activity of the principal prehistoric communities. Evidence was recovered from all types of primary mining feature, from chipping floors and from temporary camps; some of the latter concentrated around water-filled karstic sinkholes a few hundred metres south of the extraction area.

**Figure 89.** Krzemionki Opatowskie Mining Field. Key to pottery finds:
- Funnel Beaker culture (1, 5, 6, 7, 13, 14, 15);
- Globular Amphora culture (3, 4, 8, 9, 10, 11, 12, 17, 18, 19, 21, 22, 24);
- Mierzanowice culture (18, 19, 20);
- Lusatian culture (18);
- Late medieval, 12th–13th century CE (7, 10, 16, 23);
- Neman culture (13) (after Bąbel, 2015).
In the area of mines 7/610 and 4/606 a striped flint flat spearhead and the initial form of a striped flint point were found and attributed to the Bell Beaker culture.
Organisation and Methods of Working

Evidence of the various aspects of prehistoric flint exploitation (the overall making use of, and benefitting from, flint resources) give the best clues as to the way the mining system was organised. In the context of prehistoric exploitation, the term technology includes a range of techniques, skills, methods and processes. Underground mining features at Krzemionki Opatowskie Mining Field illustrate the prehistoric method of mining and deposit management (shafts, galleries, chambers, waste, and other), together with the tools used. Surface exploitation features at all three mining fields (component parts) further illustrate the prehistoric method of flint extraction, and of waste management and processing, whilst final production is evidenced at Gawroniec Settlement. We have to rely on archaeological finds of the product (axes), elsewhere, to understand distribution patterns.

Extraction

From a relatively flat denudation plain, geology descends from unconsolidated sediments into cracked rock and, finally, monolithic, hard and structurally competent limestone. The mining system was therefore fundamentally based on a combination of vertical pits and shafts and horizontal galleries and chambers. The geological engineering situation demanded creative technical mining solutions; and further favoured working methods and safety aspects at depth. This situation also aided the survival of 5,000-year-old mine workings in good condition, at variable depths, and of types that differed distinctly in morphology, horizontal extent and relatively consistent spacing between units of specific types, as determined on surface. The ensemble evident in Krzemionki Opatowskie Mining Field illustrates the greatest range of prehistoric flint mining techniques known in a single site.

Five principal types of mining extraction structures are represented (from shallow to deep):
1. open-pit
2. shaft with niche-gallery
3. shaft and gallery
4. shaft, gallery and pillar-chamber
5. shaft, gallery and chamber
Open-pit mines

The simple open pit was the shallowest ‘shaft’ sunk to extract flint nodules, extraction taking place from within the floor area of the pit, with a lateral range of exploitation of between 2 to 3 metres. They were comparatively easy to dig, probably using picks of antler and bone, with little skill needed. They were excavated in unconsolidated sands and clays and degraded limestone debris that was up-cast around the pit, into an adjacent abandoned pit, or left to erode over time as the sand-clay-limestone rubble quickly weathered down. They seldom exceeded a depth of around 2.5 metres (2 metres generally, and arbitrarily, denoting the change between pit and shaft), but sometimes reached a diameter of up to 5 metres since the structure of their walls was weak. It is assumed that two to three miners worked an open pit, the flint being taken for their own needs and usually being of a relatively poor quality as near-surface weathering had taken effect. Once abandoned, the pit was commonly backfilled with the waste from the next one, together with waste from chipping floors; such structures also suffering from general infilling, including leaf and wood debris, over the millennia. Their form in the present landscape is usually very shallow depressions, commonly around 4 to 6 metres between pit centres, clustered along an outcrop and clearly discernible by Lidar.
The shaft with a niche-gallery/niche-galleries was the next level of mining technology developed by prehistoric miners to extract flint. Nodules were extracted from the shaft bottom, and beyond by mining very short galleries (‘niches’ of around 1 metre cross-section) in multiple directions depending on the richness of the bed, to increase the floor area of extraction within the bed, but for a relatively short distance only (around 3 to 4.5 metres). A higher level of skill and technique was required to excavate these short tunnels, ensuring a stable structure and handling a greater volume of waste and output, including the use of transport baskets and ‘ladder’ access in the shaft. The shafts were still sunk in comparatively unconsolidated ground, passing down into more compacted material with a greater percentage of limestone rubble and cracked limestone, probably still using picks and wedges of antler and bone. Again, waste debris was up-cast around the shaft collar, and carried/hauled to surface as the shaft went deeper. Waste would have often been back-filled into an adjacent abandoned shaft, or left to erode over time as the sand-clay-limestone rubble quickly weathered down in the same way as for open-pits. Shafts reached a depth of around 4.5 metres, with a shaft diameter of up to several metres, perhaps 4 metres or more when the collar ‘coned’ due to weak walls; the structure of the lower walls being more competent. Flint at this depth was of better quality and it is assumed that three or four miners were required to work by this method. Once abandoned, the shaft was commonly backfilled with the waste from a new shaft, together with waste from chipping floors; such structures also suffering from general infilling, including leaf and wood debris, over the millennia. Their form today is often shallow depressions (with little surrounding shaft-sinking/mine waste), spaced typically around 6 to 9 metres between shaft centres, commonly clustered along an outcrop and clearly discernible by LIdar.
Shaft and gallery(ies) mines

Shafts with galleries, whilst common at prehistoric flint mines elsewhere in Europe (for example Spiennes, Grime’s Graves, and Rijckholt-St. Geertruid), are less common at Krzemionki where more efficient chambers were able to be developed because of the favourable structural strength of hard and well-bedded limestone that formed a ceiling above the flint bed (as opposed to softer chalk). Mine 8/669, uncovered in 1985, contains a straight, 7-metre long, gallery that extends from the base of the shaft.

Shaft, gallery(ies) and pillar-chamber mines

The shaft with gallery or galleries and pillar-chambers (‘room and pillar’) were developed to extract flint nodules of high quality at greater depths (around 5 to 6 metres) from within a stratum of hard and competent limestone. This required a step-change in the level of mining technology – of techniques, skills, methods and processes. The shaft collar had a diameter of less than 3 metres and served as an entrance to galleries that led to chambers where the ceilings were supported by natural pillars of limestone left standing in situ by the miners. Pillar-chambers in hard bedded limestone were extended up to 8 metres from the bottom of the shaft, and once the flint was extracted it was transported back to the shaft (possibly using wicker baskets but probably leather sacks, animal hair to the ground for least resistance and tearing, pulled by ropes). After some
initial knapping and quality control the flint would then be raised to surface, possibly using leather sacks, rope and windless. Waste (‘gangue’) limestone and poor-quality flint were backfilled in worked-out chambers – specifically tightly packed to the roof – therefore maximising stowage but importantly providing additional structural support. This kind of mining again required a greater level of skill, more miners (at least 5), more advanced extraction techniques using different tools, more extensive and elaborate designed safety measures, a greater degree of waste and output management and of the use of ladders or haulage in the shaft, and of course lighting. Torches, or firebrands, were used (the remains of pine torches have been found) and their flame was clearly sustained by the regular ‘cleaning’ of the charred tip by scraping it against a wall to leave the rest of the torch to burn better. Such scraped-off charcoal remnants are common in the mines; some isolated charcoal marks even clearly resemble symbols or drawings. This meaning of this prehistoric ‘mining art’ can only be guessed at.

Waste debris from shaft-sinking was up-cast around the shaft collar, and carried/hauling to surface as the shaft went deeper and the first galleries and chambers were excavated. Such waste contains a greater percentage of larger limestone pieces that tends to erode less over time and leave a spoil ring or partial ring. Some of the shafts would have been partially back-filled using this material and subsequently, over millennia, filled with other debris. Pillar-chamber mines are clearly detected by Lidar and geophysical techniques, their spatial distribution ranging from 9 to 13 metres between shaft centres.

Shaft, gallery(ies) and chamber mines

Figure 95. Interpretation of the shaft, gallery(ies) and chamber mines (author T. Piotrowski).
Large chamber mines are not known in prehistoric flint mines outside Krzemionki Opatowskie Mining Field. They are technologically the most advanced and complex, the shafts-reaching a depth of around 9 metres (shaft collars are no more than 3 metres), with single chambers ranging from 55 to 120 cm high, extending from 7 to 20 metres from the shaft and covering an area of as much as 500 square metres. They occur in specific zones of the deposit structure and demonstrate highly developed and systematic methods of deposit management, and the regular design of safety measures. More miners (perhaps up to 9 or 10) were required to work this mining unit (underground and at surface) that was likely operated for multiple seasons or even worked a number of times by multiple generations. The same extraction techniques used in pillar-chamber mines applied in the chamber mines, although being in the hardest and most competent limestone (as evidenced by the stability of the chamber ceilings) the development of tools included not only flint picks but local stone (hard igneous, volcanic and metamorphic rock) mallets, beaters and picks. A new special stone tool was developed: a cigar-shaped, thick cylindrical flint pickaxe with a sharp point and blunt hammerhead, the forerunner of a traditional miners’ pick. Again, elaborate safety measures were used, and torches were necessary to light the extensive chambers.

From evidence observed in chamber mine 4/606, such as unidirectional sweeping pick marks, communication galleries and stratified back-fill, the system of work appears to have taken place in several stages.

Extraction commenced at the base of the shaft and galleries were dug radially in three directions for distances from 4 to 7 metres. The sidewall(s) were then worked in a fan-like exploitation pattern, ripping flint nodules from ‘longwall’ working faces. The perimeter of the chamber was then extended in the same manner a second (and sometimes even a third) time, progressively extending away from the shaft. A perimeter side-wall gallery was maintained. After flint extraction and back-filling operations, radial communication galleries (in this case, three) from the shaft bottom, and perimeter side-wall galleries, were maintained until abandonment. The walls (comprising back-fill) of galleries ‘constructed’ in empty chambers were commonly lined with large retaining slabs of limestone, stacked on edge but battered for stability and a flush surface.
Figure 96. One of three communication galleries, chamber mine 4/606, Krzemionki Opatowskie Mining Field (author J. T. Bąbel).

Figure 97. Sidewall gallery at the perimeter of chamber mine 4/606, Krzemionki Opatowskie Mining Field (author J. T. Bąbel).
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Figure 98. Sidewall gallery showing back-fill retaining wall clad (boarded) with heavy slabs of limestone ripped from working faces. Back-fill extends to the roof for maximum stowage and structural support. Such galleries are economical only to be large enough for one miner to pass through in a crouching manner. Chamber mine 4/606, Krzemionki Opatowskie Mining Field (author J. T. Bąbel).

Figure 99. Evidence of the use of timbering to prevent rubble back-fill falling into galleries and blocking passageways: the white dashed line indicates a negative of a vertical timber prop/post (these have been found up to 1 metre long), whilst the red arrow indicates the negative of a horizontal timber, all set in back-fill in pillar-chamber mine 806, Krzemionki Opatowskie Mining Field (author J. T. Bąbel).
Figure 100. Working face at the final perimeter of chamber mine 4/606, Krzemionki Opatowskie Mining Field (author J. T. Bąbel).

Figure 101. Sidewall, showing flint seam at floor level and extensive signs of chiselling at the perimeter of chamber mine 4/606, Krzemionki Opatowskie Mining Field. When two seams were present, the lower seam was exploited at floor level and the other half way up the chamber wall (author J. T. Bąbel).
Once the flint was extracted it was transported back to the shaft (sledges or baskets may have been used to drag the material significant distances) and raised to surface, either up ladders (steps cut into coniferous tree trunks) or hauled by primitive windless set across the middle of the shaft so as to prevent snagging and bumping that would damage both the container and the shaft wall, particularly near the collar (traces of such construction were found at the collar of shaft 4). At Krzemionki, unlike some Neolithic flint mines elsewhere (in chalk, such as Spiennes), no vertical running abrasions have been detected. Waste limestone and poor-quality flint were backfilled in worked-out segments of the chambers, commonly tightly packed to the roof to provide additional structural support as a safety measure. When such segments of the chamber were being back-filled with waste, special communication galleries (small, narrow, pathways) were left for access and safety using large limestone slabs (on-edge) as battered (boarded) retaining walls.

Extensive waste debris from shaft-sinking was up-cast around the shaft collar, and supplemented by that carried/hauled to surface as the shaft went deeper and the first galleries and chambers were excavated. Such spoil is greater in volume than that associated with any of the other types of workings in Krzemionki Opatowskie Mining Field, and also contains a greater percentage of larger limestone pieces that tends to erode less over time and leave a distinctive ring mound or partial ring mound. Some of the shafts would have been partially back-filled using this material and subsequently, over millennia, filled with other debris. Chamber mines, with distance between shaft centres ranging from 14 to 15 metres, are clearly visible in the landscape and easily distinguished by Lidar and geophysical techniques.

**Mining tools**

The widest range, from any known prehistoric flint mine, of specialised Neolithic and Bronze Age miners’ tools were developed at Krzemionki. The range of sediments and rock types of varying hardness, bedding planes, fractures and so on prompted this development. Mining work in underground galleries and chambers was performed in a squatting or reclining position due to the height of the ceiling, therefore tools had to be relatively short and be able to be used in this confined situation with limited ability to swing unhindered. Simple tools were made of stone, flint, antler or wood, and most were used as chisels, picks, scrapers and wedges. In chamber mines a new tool was developed: a cigar-shaped, thick cylindrical flint pickaxe with a point one end and blunt hammerhead the other. The forerunner of a traditional miners’ pick.
Figure 102. Krzemionki Opatowskie Mining Field. Clear traces of prehistoric antler-picks in weathered clay in the pillar-chamber mines (author A. Jedynak).

Figure 103. Krzemionki Opatowskie Mining Field. Antler, sourced from hunted red and roe deer, and elk, made into tools: picks, chisels, scrapers and wedges (after Bąbel, 2015).
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Figure 104. Antler pick in situ underground, Krzemionki Opatowskie Mining Field (author K. Kaptur).

Figure 105. Stone tool in situ underground, Krzemionki Opatowskie Mining Field (author A. Jedynak).

Figure 106. Flint axe used for mining, in situ underground, Krzemionki Opatowskie Mining Field (author A. Jedynak).
Figure 107. Krzemionki Opatowskie Mining Field. Mining tools – axes – made from Krzemionki striped flint (after Bąbel, 2015).

Figure 108. Antler pick *in situ* underground, Krzemionki Opatowskie Mining Field (author K. Kaptur).
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Figure 109 and 110. Krzemionki Opatowskie Mining Field. Antler tools found *in situ* in 2003 in mine 795 (author J. T. Bąbel).

Figure 111. Distribution of tool finds at surface belonging to the basic mining sets, documenting work in specific geological-engineering conditions, Krzemionki Opatowskie Mining Field. Based on Krukowski fieldwork (after Borkowski, 2000) (Note the cylindrical stone picks used in deep chamber mines).
Surface mining activity

The entrance to the mine (shaft throat) was (at least in some cases) protected from the direct effects of rain and snow by cone-shaped shelters supported by a wooden framework that included a ring of upright poles driven into the soil surrounding the shaft. Evidence in the form of regular post-holes has been found surrounding several pillar-chamber mines, including mine 7/610, which made possible the interpretive reconstruction of such for visitors today. Such shelters suggest that underground work in the mine continued through the seasons.

Figures 112 and 113. Krzemionki Opatowskie Mining Field. Excavation of mine 7/610 (left), showing the edge of the shaft (higher left) with an encircling arrangement of post holes (red arrows), 16 in total (1.1–1.2 metres apart) forming an oval around 10 metres in diameter. This indicates a probable shelter over the shaft throat, with a roof area in excess of 200 m². Interpretive reconstruction based on archaeology (right) (authors: W. Borkowski (left) and J. T. Bąbel (right).

Processing

At surface, close to the active mines, in back-filled hollows of abandoned shafts and in areas of waste dumps, primary flint processing continued at chipping floors or flint knapping workshops. Chipping floor material excavated from next to shaft 5 in 1969–70, and from trenches I/79 and IV/80, has been analysed and described. It was determined that basic products were four-sided axes of both Neolithic cultures (Funnel Beaker and Globular Amphora). The chipping floor waste comprised tool and production waste from all stages of the production cycle of striped flint axes, including stone sanding plates and polishers serving to impart the final polish to the axe blades. Flat stones, sometimes sandstone or quartzite, or igneous rock strewn with wet sand or finely crumbled flint dust was used for polishing roughouts. Such stones have also been recovered from Neolithic settlement sites on the Sandomierz Upland.

A little further away, and also in areas up to several hundred metres beyond the mining field, temporary settlements dealt with the selected raw material to produce axes, or semi-finished tools that were transported to more-distant production settlements where they were finished and polished as required. These were temporary (probably seasonal) encampments, established next to drain-less funnel-shaped dolines, small karstic depressions or basins close to the mines, where temporary water collected (S. Krukowski found 11 such dolines in the southern part of the reserve. Several survive but the activities of the Steelworks company that used the quarries
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in the 1970s has either destroyed or buried some of them). Other than the dolines, drinking water on the mining field and its immediate surroundings on the wider plain was lacking, a journey on foot of between one to two hours to the Kamienna River being necessary.

It is thought that the main production settlement where striped flint axe finishing and polishing was undertaken is at the promontory of Gawroniec in Ćmielów, located in the Sandomierz Upland approximately 8 kilometres to the south-east of Krzemionki. Several other such Neolithic settlements are known from that area: in Stryczowice, Zawichost, Kamień Łukawski (Funnelbeaker culture) and upon the Gierzanka River, near Wojciechowice, Stodoly and Mierzanowice (Globular Amphora culture). Gawroniec, however, is easily the largest Funnel Beaker culture settlement near to the nominated Property (the series of three mining fields in the limestone basin rocks of the Magonie-Folwarczysko Syncline) and prolific striped flint waste has been yielded from the excavation of flint-knapping workshops during the 1950s.

Post-mining landscape

The Kamienna River Basin, particularly the area between Ćmielów and Ostrowiec Świętokrzyski, was among the Europe’s biggest flint mining regions. The Krzemionki mines operated between 3,900 and 1,600 BCE, but flourished particularly over the period of the Globular Amphora culture (2,900–2,500 BCE). The decline of flint mining came with the arrival, at the turn of the 3rd millennium BCE, of bronze as a new material for the manufacture of ornaments, weapons and tools. However, flint remained in use for a long time, yet any further mass production was out of the question.

When flint extraction ceased during the Early Bronze Age, the mining fields became naturally re-forested with a succession of pine, sessile oak (Quercus petraea), and sporadic birch and aspen. The characteristic hummocky landscape of shaft hollows and primary and secondary waste heaps, whilst a valuable prehistoric industrial landscape of great scientific interest today, remained of little use to anyone. They were sporadically visited for hunting and the minor extraction of clay.

Until the early twentieth century, the mining fields (three component parts) remained covered – and protected – by forest. Borownia and Koryczna remain so, whilst Krzemionki suffered from at least some clearance and ploughing in the 1910s and 1920s, causing some destruction to surface features, but the forest has since regrown.

Prehistoric mining communities

In addition to Gawroniec Settlement, a component part of the Krzemionki prehistoric striped flint mining region, a number of Neolithic and Bronze Age settlements are distributed in the lower Kamienna valley, a key part of the setting. They are associated with three basic cultural groups that were involved in flint mining in the region, namely the Funnel-beaker culture (kultura pucharów lejkowatych – KPL), Globular Amphora culture (kultura amfor kulistych – KAK) and Mierzanowice culture (kultura mierzanowicka – KM). Research covered an area of about 200 km\(^2\) covering the section of the Kamienna valley from Grójec to Rudka Bałtowska, and a fragment of the right tributary basin – Przepaść, lying on the Sandomierska Upland (Wyżyna Sandomierska),
and the areas on the left and right banks lying within Iłżeckie Foothills (Przedgórze Iłżeckie). It closes approximately in a rectangle stretching to the north to Rudka Bałtowska, in the west of Maksymilianów, Sudół, Grójec, in the south of Trębanów and Mierzanowice, and in the east – Jasic, Gliniany and Duranów. Administratively, the studied area lies within the districts of Opatów and Ostrowiec Świętokrzyski, in the Świętokrzyskie Province and includes in part the following communes: Bałtów, Bodzechów, Ćmielów, Opatów, Ożarów, Sadów, Tarłów, and Wojciechowice. There are 13 of the 14 known prehistoric flint extraction points in the research area, including all related to the exploitation of striped flint. The two physico-geographical mesoregions mentioned in the study area constitute completely separate landscapes and environment areas with contrasting suitability for settlement.

Sandomierska Upland is a region where the Paleozoic and Mesozoic rocks are covered by a thick cover of loess, on which fertile brown soil and black soil were formed. These features are incised by the dense water network of the Kamienna, Opatówka and Koprzywianka with its tributaries, creating extensive valleys. In total, this creates very favourable conditions for settlement, and the region is almost 100% covered by agricultural and fruit growing.

The Iłżeckie Foothills are built of Mesozoic rocks, predominantly Jurassic. The water network is very poor. It is also a region with less landscape diversity. Stretches of rock outcrops running northwest-southeast are separated by hollows filled with Quaternary formations (sands and clays), which means that there are no large differences in relative height. One of the most interesting parts of Foothills is the landmark part of the Kamienna valley, which in the study area flows along a several-kilometre stretch from the south to the north, cutting Jurassic carbonate rocks carrying flint raw materials. This is also the region where prehistoric flint mines are located. The area of Iłżeckie Foothills is largely covered by forest, with the largest complex of the Iłżecki Forest with an area of about 25,000 hectares, the eastern part of which covers the area of study.

The source database for the preparation of this study was the results of the research of the Archaeological Picture of Poland conducted in the years 1990–2009. All locations with a certain chronology (divided into cultures), both excavated and known only from surface or accidental finds, qualified for the analysis. Categories were created based on size – small settlements up to 0.5 ha and large settlements over 0.5 ha, and based on function – with settlements and settlement points, cemeteries as well as flint workshops and traces of flint processing. The geomorphological location of the site (upland, valley slope, bottom of the valley) and soil type classification (sandy, loamy) where the materials were discovered were also analysed. In total, 151 KPL sites, 37 KAK sites and 155 KM sites were analysed, as well as 152 sites defined generally as dated to the Neolithic or early Bronze Age, some of them being multicultural sites.

Due to the registration of a large number of archaeological sites dated generally to the Neolithic and / or Early Bronze Age, i.e. from the period of interest, a separate classification category was created. Both Neolithic and early Bronze Age ceramic materials (without specific membership in one of the three cultural formations considered) qualified, but also where only floc materials were registered (or mostly) during the treatment of striped flint material in the area of deposits, that is, flint traces and flint workshops. These are positions that certainly functioned in the times of operation of the flint mines over the lower Kamienna, but there are no precise dating materials.
Funnel-beaker communities (kultura pucharów lejkowatych – KPL)

The analysis covered 151 archaeological sites, most of which are located within the Sandomierz Upland (140), and only a few in the Iłżeckie Foothills (11). Only a few of them (6) were excavated. These are the Gawroniec Settlement (nominated Property) on the 1/1 stand in Ćmielów (‘Gawroniec’ hill), Lemierze st. 5/99, Podgorzó st. 7/66, Podgajcze st. 1–2 / 8, Rudka Bałtowska st. 2/77, Boria st 1/82. There were 74 sites with an area of up to 0.5 ha and 49 above 0.5 ha, as well as 28 sites without a certain range (archival) coverage, separated in terms of size. When assessing the position of KPL, 104 settlements and 45 settlement points were distinguished, as well as one cemetery and one flint workshop. Analysing the locations in relation to the river network, it was shown that 8 of them are located within the valley bottom (including valley terraces), 43 on the valley slope, 16 partly on the plateau, and partly on the slope, and 61 on the plateau. For 23 positions, researchers did not specify the exact location (archival).

Most of the analysed KPL sites (almost 50%) are small settlements and settlement points with an area of up to 0.5 ha. Large settlements (over 0.5 ha) account for 32%. Numerous cemeteries of this culture, including megalithic ones, such as Stryczowice, Garbacz, Malice Kościelne, Pawłów and Kichary Nowe are known from the Sandomierska Upland. Probably also a large part of the locations placed in the group 'Neolithic and early Bronze Age' can be attributed to this cultural unit. There is a clear disparity between the Sandomierska Upland and Iłżeckie Foothills in the deployment of the KPL posts. This is due to the obvious fact of much lower usability of settlements in the Foothills area. The exception here is the Kamienna valley, where all convenient places are used for settlement. The extension of the valley between Boria and Rudka Bałtowska, in the northern part of the analysed area, was clearly a convenient place for settlement, there being two settlements with an area of approximately 5 ha and a few smaller ones. Most settlements are located in the Sandomierska Upland area. These are both small and large settlements of the ‘Gawroniec’ estate type. 6 positions with an area similar to stand 1 in Ćmielów were registered here; however, these are multicultural sites and their area has been generally defined for the entire site. Against this background, the Ćmielów settlement appears in a unique light as an almost monocultural site.

The vast majority of settlements are located in the valleys of the Przepaść and Krzczonowianka rivers and their immediate vicinity as well as in the edge zone of the Sandomieska Upland descending into the Kamienna valley. At various places referred to as part of the bottom of the valley, very few sites are located (5%). A clear dependence of settlement on the type of soils shows their distribution mainly on heavy soils – loess and loamy loess within the Sandomierska Upland. One of the two larger groupings of sites in Iłżeckie Foothills, located between Podgorzó (Kamienna) and Julianów, is also associated with a locally occurring loess cover.
Figure 114. Settlement of Funnel-beaker culture in Krzemionki prehistoric striped flint mining region: a – flint mines, b – settlements above 0.5 ha, c – sites up to 0.5 ha (authors: U. Jedynak and A. Jedynak).
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Figure 115. Funel-beaker culture pottery from site ‘Gawroniec’ (after Podkowińska, 1950).

Figure 116. A vessel produced by the Funnel Beaker culture: a cup with the ansa lunata handle (author A. Jedynak).

Figure 117. Handle of vessel with image of two head of ram (after Bąbel, 1986–90).
Globular Amphora culture (kultura amfor kulistych – KAK)

The analysis covered 37 archaeological sites, most of which, similarly to KPL, are located within the Sandomierska Upland (30), and 7 in the Iłżeckie Foothills. So far, 9 sites have been excavated, including: a settlement at 63/28 in Krzczonowice, a settlement at 2/77 in Rudka Bałtowska, settlement – site 14/3 in Sudół-Krzemionki, settlements in positions 1, 3, 4 and 5 in Mierzanowice, in Grójec, st. 24/428, Podgajcze st. 1–2 / 8 and a flint mine in Sudół-Krzemionki, st 1/1.

In terms of size, 13 sites with an area of up to 0.5 ha and 13 more than 0.5 ha were identified, as well as 11 sites without a certain range (archival). When assessing KAK’s positions in terms of function, there were 25 settlements and 7 settlement points, as well as 4 cemeteries and one flint workshop. Analysing the location of the stands in relation to the river network, it was shown that 2 of them are located within the valley bottom (including valley terraces), 11 on the valley slope, 10 partly on the plateau, and partly on the slope, the next 11 on the plateau, and on 23 positions on the researchers they did not specify the exact location (archival).

In the case of the analysed KAK sites, the number of small settlements and settlement points with an area up to 0.5 ha is equivalent and constitutes 35% of the total number of posts. 88% of the sites are residential, but the number of known cemeteries is clearly higher than in the case of KPL – 11%. Flint workshops and flint processing account for about 3%.

Also in the case of the Globular Amphora culture, there is a big difference in the number of sites on the Sandomierz Upland, compared to Iłżeckie Foothills. However, there is a noticeable increase in the number of positions located in Foothills, in proportion to the total number of KAK stands. However, the absolute number related to both cultures is similar (11 – KPL, 7 – KAK). Also, as in the case of KPL on Iłżeckie Foothills, the largest number of settlement points and settlements is located by the Kamienna river, although in the vicinity of flint mines located on uplands there are single settlement points directly related to the exploitation of flint, such as miners’ camp 14/3 in Sudół-Krzemionki (‘Onion Feces’). However, this is not a compact settlement. We can only talk about KAK in relation to the Krzczonowianka and Przepaść basin on the Sandomierska Upland. We deal here with both large settlements (over 0.5 ha) and small settlements, some of which are finds of single tools. In the group of large settlements, at least 4 can be observed with an area of over 5 ha, located in Buszkowice, Krzczonowice and Bidziny. However, the same problem applies to large KPL settlements in this area. Their ranges are known only from surface studies, and these are multicultural sites. The areas of excavated or geophysical deposits from the discussed area (eg Krzczonowice 63, Mierzanowice 1 and 4) do not exceed 1.5 ha.

In the case of KAK, the location of stands in relation to geomorphological forms of the area does not show any clear tendencies. Nearly 1/3 of the stands are located on the plateau, on the slope and in the plateau, or clearly on the slope. Only a small percentage of stands (about 5%) were located within the lower parts of the valleys. As in the case of KPL, most stands are related to heavy loess-clay soils, although the proportions, due to the different overall number of sites, are not so clear.
Figure 118. Settlement of Globular Amphora culture in Krzemionki prehistoric striped flint mining region: a – flint mines, b – settlements above 0.5 ha, c – sites up to 0.5 ha (authors: U. Jedynak and A. Jedynak).
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Figure 119. Krzczonowice, site 63. View of settlement from north-east (author K. Kaptur).

Figure 120. An axe produced by the Globular Amphora culture (author A. Jedynak).

Figure 121. Krzczonowice, site 63. Typical vessels (author A. Jedynak).
Mierzanowice culture (kultura mierzanowicka – KM)

In the case of this culture, the analysis concerned the largest group of 155 archaeological sites compared to other cultures. Also, as in the case of KPL and KAK, most of them are located within the Sandomierska Upland (123), and 32 in the Iłżeckie Foothills. Excavation tests have so far been carried out on 8 sites, including, *inter alia*, mines of striped flint in Krzemionki (Sudół-Krzemionki 1/1), settlement at site 2/77 in Rudka Baltowska, settlement – camp site 14/3 in Sudół-Krzemionki, settlement at 98/8 in Lemierze and settlements at 1/66 and 4/69 positions in Mierzanowice. Analysing the ‘Mierzanowice’ stands by size, 77 sites were up to 0.5 ha, 48 above 0.5 ha, and 30 sites were identified without a certain range, and thus unknown (archival) area. In terms of function, 96 settlements and 53 settlement points of KM were distinguished, as well as 3 cemeteries and 3 flint workshops. Analysing the location of sites in the field, there were 5 locations within the valley bottom (including valley terraces), 67 on the valley slope, 47 partly on the plateau, and partly on the slope, 9 on the plateau, while 27 researchers found no precise location (archival).

In the case of the group of analysed KM locations, there around 50% small settlements and settlement points with an area up to 0.5 ha. The large settlements are almost 31%, while the number with undefined by researchers amounts to slightly more than 19%. In total, approximately 96% of all locations are residential. The percentage of cemeteries is small and amounts to 2%, as in the case of flint workshops.

The distribution of sites within the Sandomierska Upland and Iłżeckie Foothills is similar to that in KPL, however with the largest number of registered settlement sites in Foothills. Similarly, as in the case of Neolithic settlements, settlements are spread over almost the entire length the Kamienna Valley, with a larger grouping north of the prehistoric mining fields ‘Borownia’, ‘Nowa’ and ‘Krunio’ lying adjacent to the right bank of the valley.

The distribution of settlements on the Sandomierska Upland looks interesting. They ‘occupy’ both banks of the Krzczonowianka and Przepaść rivers, similarly to the KPL settlements, and there are definitely more of them than the KAK settlements. KM settlements are mostly close to each other in size. The location of stands in relation to geomorphological forms which are river valleys clearly distinguishes them from other cultural units. 73% of the settlements are located on the slope of the valley or the border of the slope and the top. Less than 6% were located at the top of the hills, while slightly more than 3% at their foot and at the bottom of the valley. 17.5% of positions carry no data on their location.

As in the case of KPL and KAK, most sites are associated with soils produced on loess and clay, however, settlements always occur near water. Loess patches on the anhydrous river in the investigated area of the Iłżeckie Foothills are not inhabited.
Figure 122. Settlement of Globular Amphora culture in Krzemionki prehistoric striped flint mining region: a – flint mines, b – settlements above 0,5 ha, c – sites up to 0,5 ha (authors: U. Jedynak and A. Jedynak).
2. Description
2.b  History and Development

Figure 123. Eponymic site no. 1 in Mierzanowice (author A. Jedynak).

Figure 124. Typical finds of the Mierzanowice culture (author A. Jedynak)

Figure 125. Mierzanowice. site 1. Grave 37. Amphora (after Bąbel, 2013)

Figure 126. Mierzanowice, site 1. Grave 153 (after Bąbel, 2013)

Figure 127. Mierzanowice. site 1. Burial goods from grave 71 (after Bąbel, 2013).
Locations generally based on the Neolithic and Early Bronze Age period (NE and WEB)

A large number of registered stands of the above resulted in the necessity to include them as a separate group, due to the fact that the characteristics of materials discovered there allowed only their general assignment to the middle and late Neolithic or early Bronze Age or their possible connection with the mining of striped flint.

In general, 152 locations were included in this category, of which 90 (61%) are located in Iłżeckie Foothills, and 62 (39%) in the Sandomierz Upland.

As in the case of other locations with assigned chronology, analyses of their size, type (function) and location were made. Due to the size of the area occupied, 137 sites were in the range of up to 0.5 ha, in 6 cases an area of over 0.5 ha was found, and in 9 there was no such data. In terms of function, the division of the stands of this group is as follows: settlements and settling points – 95, flint workshops – 16, flint traces – 38, cemeteries – 3.

Analysing the location of Neolithic and early Bronze Age sites, it can be concluded that the vast majority is located on the plateau (63) or partly on the plateau and slope (50). Only 21 positions were located on the slopes, while 9 were in the valley.
2. Description

2.b History and Development

Figure 130. Middle-late neolithic and early bronze archaeological sites in Krzemiański prehistoric flint mining region: a – flint mines, b – flint workshops and flint traces, c - settlements and settling points (authors: U. Jedynak and A. Jedynak).
The above data indicates that most of them are related to the prehistoric flint mining. Almost 2/3 of them are located in the Ilżeckie Foothills, in the vicinity of the prehistoric flint exploitation sites. These are usually small stands. Although they were mostly referred to as settlements and settlement points, a considerable part of the artefacts found on them are flint materials. An exceptionally high percentage in comparison to stands attributed to individual cultures are flint workshops and flint processing evidence. The number of settlement stands located on or in the plateau is much higher than in the case of the other analysed sites.

**Summary**

The analysis of the contemporary settlements in the region surrounding the prehistoric mines of striped flint on the lower Kamienna River brings the following conclusions:

- there is a visible difference in the number of sites present on the Sandomierska Upland and Ilżeckie Foothills (Przedgórze Ilżeckie), which was obviously caused by different conditions for settlement between the two areas.
- There is a quality difference between the sites located in each area. Notably, the big earthen structures which are present in the Upland do not exist in the Foothills area.
- The sites differ in terms of their primary purpose as well – while those at the Sandomierska Upland had mainly housing and sepulchral function, those located at the Ilżeckie Foothills are connected to flint exploitation.
- It appears a key role has been played by the Kamienna River, which became a ‘settlement corridor’ providing a connection between the densely settled Sandomierska Upland and the mining area of Ilżeckie Foothills.
- It is interesting to draw a comparison between the locations of KPL (Funnel Beaker Culture) and KM (Mierzanowicka Culture) settlements. They both seem to be equally dynamic, the concentration of settlements is similar however the location of the two varies (KPL is located higher and KM lower).
Discoveries of Prehistoric Flint Mines in Europe

Some key events in the discovery of European Neolithic flint mines during the second half of the nineteenth – and the early twentieth centuries occurred during a period of significant developments within the emerging discipline of prehistoric archaeology.

These discoveries initiated modern research and contributed to the interest of prehistoric flint mining in Europe (including Poland), of provenance studies of striped flint axes, and ultimately the discovery of *Krzemionki prehistoric striped flint mining region* in 1922 (for a fuller description of these, and other prehistoric flint mines, see section 3.2 Comparative Analysis).

*Figure 131. Spiennes (Belgium), farm of the rue du Point du Jour (author Jean-Pol Grandmont, source: Wikipedia).*
Spiennes (Belgium)
1867
In 1867 in Spiennes, Belgium, dramatic discoveries of Neolithic flint mines were made in a new railway cutting along the side of a hill. These were communicated in the following year in ‘sur les découvertes géologiques et archéologiques faites à Spiennes’ (Briart et al. 1868). In Poland, the first formal report appeared following the International Congresses of Anthropology and Prehistoric Archaeology in Brussels, written by Count J. Zawisza, father of Polish prehistoric research (Collet, H, et al, 2008)

Cissbury (UK)
1867–68
Neolithic flint mining sites in the UK had been wrongly ascribed – in terms of function and date – since the mid-nineteenth century (for example as ancient British fortifications: Grime’s Graves in 1852 and Cissbury in 1856). However, at Cissbury, excavations began in 1867 and ultimately led to the discovery of galleried shafts that were eventually, and correctly, identified as prehistoric flint mines.

Grime’s Graves (UK)
1868
Excavation began at this most famous of the UK prehistoric flint mines in 1868, prompted it is said by the discovery at Spiennes. It was the first underground excavation to reveal evidence for shafts with galleries radiating from their base (it was also speculated at the time that some of the galleries visible at the base of the shafts might join up with neighbouring shafts; something that later proved to be correct). Numerous antler picks were recovered.

Rijckholt-St.Geertruid (The Netherlands)
1881
Prehistoric flint mines were discovered in 1881 in the slopes of the eastern Meuse valley, between Rijckholt and St.Geertruid, and studied by Belgian archaeologists. It was not until 1923–25 that irrefutable evidence of function and dating was provided with the discovery of an extensive underground mining gallery system.

Krzemionki, Borownia, Korycizna
1922
Discovery of the Neolithic Krzemionki Opatowskie Mining Field by Jan Samsonowicz, a geologist and palaeontologist (Borownia and Korycizna Mining Fields also recognised as Neolithic flint mines).
Awareness of striped flint

During the second decade of the twentieth century German prehistorian and archaeologist Georg Wilke studied the distribution of prehistoric artefacts made from striped flint and, in 1917, published a map of their occurrence. A second map was published in 1918 by another German archaeologist Gustaf Kossina. The artefacts all came from Krzemionki prehistoric striped flint mining region; not that this provenance was then known, or the mines had yet been discovered. Axes of the Funnel Beaker culture were distributed in a radius of 250 kilometres of the nominated Property, and axes of the Globular Amphora culture over 650 kilometres. Those of the Mierzanowice culture were distributed up to around 85 kilometres. Striped flint is absent from the inventories of the Zlota culture and striped flint axes are also absent from the inventories of the Corded Ware culture.

Figures 132 and 133. Georg Wilke (1859–1938), a German prehistorian, was the first to publish a map of the occurrence of striped flint prehistoric artefacts (in 1917) (left) (after Piotrowska, 2014). Gustaf Kossinna (1858–1931) one of the most influential German prehistorian of his day. creator of the techniques of Siedlungsarchaeologie, or ‘settlement archaeology’ (right) (source: https://pl.wikipedia.org/wiki/Gustaf_Kossinna).
Figure 134. Striped flint artefact distribution published by G. Wilke 1917, Plate VI:12, Mannus (after Piotrowska, 2014).

Figure 135. Mapping of striped flint artefact diffusion, published by archaeologist G. Kossinna 1918, Plate IV (after Piotrowska, 2014).
Between 1911 and 1914, 24 homesteads were constructed within the confines of the contemporary Krzemionki reserve. 15 were located in the mining field, or in its direct vicinity, and parts of the forest were felled, and soil cultivation (ploughing) damaged or destroyed some remains of flint processing workshops located on the surface. Household limestone quarries were developed into the 1920s, destroying some of the deeper underground workings of prehistoric mines. When the reserve was created, and quarrying within it prohibited, a sector of prehistoric chambers partially destroyed by one such quarry was preserved. Today, the so-called ‘Great Chambers’ – together with Neolithic shafts 1, 2 and 3, and their associated galleries and chambers – form part of the underground visitor route that conveys the full history of the property and the damage that indiscriminate extraction can do to the historic environment, however small the scale may be.

Figure 136. Limestone quarrying west of Janicki’s Farmstead, circa 1920s, which destroyed a number of chamber mines in the northern limb of (the parabolic-shaped) Krzemionki Opatowskie Mining Field (after Piotrowska, 2014).

Figure 137. Area of Neolithic chambers severely degraded by 1920s limestone quarrying, visitor route (‘Great Chambers’), Krzemionki Opatowskie Mining Field (author B. Gamble).
Although authenticity and integrity of Krzemionki Opatowskie Mining Field is comparatively high, significant damage was inflicted during the early twentieth century by limestone quarrying in the northern limb (8), and some surface damage to prehistoric topography including flint knapping workshops, by ploughing (5) into the margins of the mining field in several places, and to its southeast end. The limestone quarries in the south (4, old Bodzechow Quarries, outside the archaeological reserve but inside the nature reserve) served as a dump for industrial waste but the site was capped with soil, landscaped and re-cultivated, the project being completed in 2014.

1 – Nature Reserve boundary; 2 – Prehistoric mines; 3 – Fence; 6 – Ploughed over karstic sinkholes; 7 – ‘Big Hole’; 9 – Museum (site of former farm buildings, outside mining field) (after Bąbel, 2015).

Krzemionki Colony with, in the foreground, a margin of the mining field deforested and grubbed out for agriculture, 1934 (after Piotrowska, 2014).
Figure 140. Archaeological and mining works in underground excavations, 1950s (author D. Kostkowski).

Figure 141. Map of distribution striped flint (after J. Lech).
2. Description

1921

In 1921, Stefan Krukowski characterised striped flint for the first time, calling it ‘Astarcian flint’ (currently known as Jurassic, Upper-Oxford flint).

1922

On 19 July 1922 Jan Samsonowicz, a geologist and palaeontologist (Polish Geological Institute) who was also working with Stefan Krukowski, discovered the Krzemionki Opatowskie Mining Field and recognised it as belonging to the Neolithic period.

1923

In 1923, archaeologists Stefan Krukowski and (assistant) Zygmunt Szmit carried out the initial inventory of the mining field.

1925

In 1925, the first professional excavation works took place in Krzemionki Opatowskie Mining Field when Dr. Józef Żurowski, Prehistoric Monuments Protection Instructor of the West Lesser Poland and Silesian District, removed the rubble from seven shafts.

1926

In 1926 Zygmunt Szmit returned to Krzemionki Opatowskie Mining Field to continue research.

Figure 142. Jan Samsonowicz (1888–1959), a geologist working with S. Krukowski, who discovered the Neolithic flint mine at Krzemionki (c 1917–20) (after Bąbel, 2015).

Figure 143. Jozef Zurowski (1892–1936), the first to excavate Krzemionki (after Bąbel, 1999).

Figure 144. Zygmunt Szmit (1895–1929), prehistorina of the Stone Age who trained under S. Krukowski (after Piotrowska, 2014).
1926 saw the beginning of a campaign to create a reserve by the gradual purchasing of land from farmers (the process culminated only in the 1960s when the whole village of Krzemionki was relocated and the village name Krzemionki was removed from the register of Polish place names). From 1928 to 1932 around 24 hectares of Krzemionki Opatowskie Mining Field were purchased, thus creating the rudiments of the archaeological reserve. This was made possible due to donated funds from the Natural Culture, Ostrowiec plant, Opatów Poviat Council, Branch of the Polish Landscape Society in Ostrowiec, and private workers of the National Archaeological Museum.

1928

From 1928 to 1938, the site was examined in detail by S. Krukowski.

Figure 146. Krzemionki Opatowskie Mining Field. Excavation of three shafts, 1930/31, with Stefan Krukowski (top left) standing in one of the shafts (after Piotrowska, 2014).
1929

In 1929 Stefan Krukowski succeeded in the delineation of Krzemionki Opatowskie Mining Field. He discovered a unique pillar-supported chamber in the north part of the mining field with charcoal drawings of lightning, bull horns and feet. Unfortunately, the chamber collapsed.


From 1929 to 1952 and 1968 to 1978, the National Archaeological Museum (PMA), Warsaw, administered the Krzemionki Archaeological Reserve.

Figure 147. Krzemionki Opatowskie Mining Field, protective shelters over excavated prehistoric mines, 1930s (after Bąbel, 2015).

The Krzemionki Archaeological Reserve has been explored by several further generations of archeologists, and continues to be so: M. Drewko (1945, 1948), T. Żurowski (1953, 1958–1961), J. Kowalczyk, B. Balcer and Z. Krzak (1969), J. Bąbel (1979–1984, 2001–2006), J. Lech (1979, 2015–2017) S. Sałaciński, M. Zalewski, W. Migal (1985–1988), W. Borkowski (1989–2000), A. Jedynak and K. Kaptur (2008–2014). As a result of the research, a large volume of data has been obtained about the geology and tectonics of the mining field and its organisation, the types of mines, their chronology and cultural affiliation, extraction techniques, operating systems, deposit management, production and distribution of flint tools, ownership relations in the mining field, as well as about the settlement in the area of the mining field and the prehistoric art and religion. There have been a considerable number of publications and scientific papers (see Bibliography, section 7e).

1944

During World War II, in the summer of 1944, the occupying German army began to build a line of defence fortifications from the north to the south of Poland. Krzemionki Opatowskie Mining Field was dissected by trenches in three places, a system of linear zig-zag trenches with minor bifurcations, 1.5 metres deep. These were (and can still be located) in the vicinity of what is now the primeval village interpretive area. Some bunkers were also constructed but in January 1945 the advance of the Russian Red Army was so rapid that the defences were never used.
2. Description

2.b History and Development

Figure 148. Documentation of the German World War II trenches made by archaeologist Michal Drewko, the first post-war conservator of Krzemionki Opatowskie. Most of the system was filled in but several obvious traces remain (after Bąbel, 1975; photo A. Jedynak).

1945

After the end of World War II in 1945, the entire area of Krzemionki Opatowskie Mining Field was excluded from the cultivation of crops. At the same time, Borownia and Koryczna mining fields were also examined with the aim of monument protection.

Figure 149. Examination of Borownia Mining Field, 1945.
In 1946 the Regional Monuments Inspector (based in Kielce) issued a Decision recognising the area of the Neolithic flint mines as a monument and establishing a reserve (Decision No. 1). In subsequent years, due to works on the reserve, some residents were resettled.

**Figure 150.** Reporting on geology in the vicinity of the Krzemionki Opatowskie Reserve, 1946.

**Figure 151.** Establishment of the Krzemionki Opatowskie Reserve, 1946.
Late 1950s

Mine ownership and specialisation of underground mining and of flint processing/axe production required permanent residence/settlement in the region. This was Gawroniec Settlement where almost 88,000 flint artefacts (assumed at around 10% of the total likely to be present at the only partially excavated settlement) were recovered from the archaeological investigation; 80,000 as assemblages (and some caches) in pits and circa 7,800 from the tilled horizon, representing the simultaneous massive use predominantly of two flint types: Krzemionki striped flint almost 56%, and Świciechów spotted flint almost 44%. Over 97% of artefacts were processing waste and blanks, the Krzemionki striped flint artefacts importantly being associated with axe production and repair (initial forms and half-products, polished only in the blade section; larger axes for felling trees and smaller ones for handicraft purposes such as working wood, bone, antler, hide and for food preparation, and for flint mining) with Gawroniec being the only settlement discovered with such a prevailing occurrence. Świciechów flint was mostly confined to an association with blade production.

In terms of ceramics, production was very rich. The dishes created here were very diverse: in addition to large storage vessels there were small funnel-shaped cups and pots with ram-shaped ears, so-called ear-cups, ‘ansa lunata’ type holders, as well as flasks with a flange. Archaeologists have also found a large number of ceramic whorls used in the weaving process, and clay pipes.

Figure 152. Archaeological excavation at Gawroniec Settlement in the 1950s.
In the late-1950s tourists first came to see the mines after Tadeusz Żurowski cleared the underground parts in the vicinity of Shafts numbers 1, 2 and 3.

1960s

In the second half of the 1960s, two temporary pavilions were built (one for staff and one for exhibition) together with storage facilities.

Figure 153. Structural roof support using brick piers, Krzemionki Opatowskie Mining Field, 1950s (author D. Kostkowski).

Figure 154. Museum archaeologist Z Krzak pointing to a negative of a flint nodule in a prehistoric working face (author D. Kostkowski).

Figure 155. Archaeologists accommodation built 1959/60 (author D. Zarzycka).

Figure 156. Krzemionki Opatowskie, 1960s (author D. Kostkowski).

Figure 157. Krzemionki Opatowskie, 1960s (author D. Kostkowski).
In the south of the nature reserve (outside the archaeological reserve) a limestone quarry owned by a local steel company was used to dump factory waste.

**Figure 158.** Defunct limestone quarry, 1 kilometre south of Krzemionki Opatowskie Mining Field. The quarry was filled with industrial waste but capped with soil and re-cultivated in 2011 (author A. Łada).

**Figure 159.** Quarry face retained for interpretive purposes of the geological profile (author B. Gamble).

### 1970s – 1980s

During the 1970s and 1980s, excavations in the mining field were conducted by the State Archaeological Museum in Warsaw. This led to the execution of the first short section of an underground tunnel, completed in 1985. It was termed an exhibition tunnel and was officially opened as the Krzemionki visitors’ mine, the world’s first tourist route presenting an underground part of a Neolithic mine to a broad audience. The tunnel traced around excavated shafts 1, 2 and 3 (Tourist Route 1) and was constructed by deepening selected spots by around 1 metre at a length of 110 metres. Since 1979 the Krzemionki reserve has been administered by the Regional Museum (currently the Historical and Archaeological Museum) in Ostrowiec Świętokrzyski. It organises funds for archaeological research and invests in all mining and construction works within the reserve. Since 2001 the Museum has conducted archaeological research, under the guidance of a special Commission, within the reserve.

### 1990

In 1990 a second visitor route was completed. In contrast to the first route, a different technique was used in that an exhibition corridor was cut into the rock to create a circuitous viewing tour of the well preserved chamber mine 7/610 (shaft 7, Tourist Route 2). Since 1991 visitors have had the opportunity to experience this prehistoric mine through special inspection windows allowing views of many features inside impressive chambers.
1991–1992

In 1991 to 1992 a reconstruction of a prehistoric settlement, including Neolithic and Bronze Age huts, a moat and a palisade, was opened at Krzemionki.

Figure 160. The reconstructed Neolithic flint miners’ village, immediately outside Krzemionki Opatowskie Archaeological Reserve, gives visitors – and particularly children – a hands-on insight to social and spiritual aspects of prehistoric life, and death (author A. Jedynak).

1994

On 8 September 1994, the Neolithic flint mines in Krzemionki were recognised as a Monument of History, by Order of the President of the Republic of Poland Lech Wałęsa.

1995

In 1995 Krzemionki was recognised as a nature reserve, by Order of the Minister of Environment, Natural Resources and Forestry (currently with an area of approximately 379 hectares).

1999

In 1999 the boundaries of the Krzemionki archaeological reserve were determined by the Regional Conservator of Monuments of the Świętokrzyskie Voivodeship in Kielce (currently with an area of approximately 326 hectares).

1999–2001

From 1999 to 2001 a Standing Conservation Commission for the Krzemionki Opatowskie Archaeological Reserve was formed at the Office of the General Conservator of Monuments in Warsaw and was directed by Professor Jacek Lech.
2002

In 2002 a pavilion was constructed with an interpretive reconstruction of a flint-processing workshop.

Figure 161. Reconstruction of a flint-knapping workshop adjacent to a niche-gallery shaft, Krzemionki Opatowskie Mining Field (author A. Jedynak).

2001–2004

From 2001 to 2004 an underground gallery was constructed to join visitor routes 1 and 2. This work was done by a team from the Historical-Archaeological Museum in Ostrowiec Świętokrzyski, owned by the local government. Part of the newest section of the route intersects Neolithic pillar-chamber mines, while the connecting sections were excavated in solid limestone rock, intersecting the natural flint-bearing bed.

Figure 162. Visitor route, new connection in solid limestone and intersecting the flint seam, Krzemionki Opatowskie Mining Field (author K. Pęczalski).
The visitor route in its present form is 465 m long, descending 11.5 m at the deepest point. It provides for safe and organised sightseeing of superbly well-preserved prehistoric mines of striped flint and introduces visitors to the geology of the region. It also illustrates how the prehistoric mines were protected and preserved in the past half a century.

2004

In 2004 a connected underground visitor route was opened to include several further Neolithic chambers and part of the underground limestone quarries so-called the ‘Great Chambers’.

2009

In 2009 the Krzemionki Opatowskie Reserve was inscribed on the European list of protected areas under Natura 2000.

2009

In 2009 an interpretive exposition of a shallow niche mine was completed, together with a visitors’ bridge to provide an overlook of the anthropogenic surface of the mining field on the way to the shaft descent underground. Thus, the comprehensive public presentation programme of Krzemionki Opatowskie Exploitation Field was concluded.

Figure 163. Interpretive exhibit in an excavated niche-gallery mine, Krzemionki Opatowskie Mining Field (author K. Pęczalski).
2. Description

2.1 History and Development

Figure 164. The width of Krzemionki Opatowskie Mining Field is crossed at the apex of the parabola by the main visitor route. A light timber bridge spans the archaeology of shaft hollows and hummocks and leads to the underground tour (author K. Pęczalski).

2011–2012

From 2011 to 2012 (completed 26 April 2012) a construction project outside the reserve comprised a new museum complex, car and bus parking, artefact storage, conference facility, visitor centre and tourist information service. The museum now offers an exhibition on the natural values of the reserve and their transformation as a result of the activities of Neolithic miners, and an archaeological exhibition.

Figure 165. ‘Krzemionki’ Archaeological Museum and Reserve and associated facilities, 2012 (author K. Pęczalski).
In 2016 Krzemionki prehistoric striped flint mining region was inscribed on the Polish Tentative List as the first stage of the nomination process to inscribe the Property on the UNESCO World Heritage List.

**Figure 166.** Chipping floor revealed in archaeological excavations at Krzemionki Opatowskie Mining Field, 2016 (author J. Lech).

**Figure 167.** Archaeological excavations begin, 2016 (author J. Lech).

**Figure 168.** Archaeological excavation at Borownia, 2017, revealing a Bronze Age hand-sized backed knife (author J. Lech).
3. Justification for Inscription
3.1.a Brief Synthesis

Krzemionki prehistoric striped flint mining region is located from 8 to 15 kilometres northeast, east and southeast of Ostrowiec Swietokrzyski, in the north-eastern fringe of the Holy Cross Mountains in central Poland. It is a serial Property comprised of four component parts: the principal Krzemionki Opatowskie Mining Field; two smaller mining fields, Borownia and Korycizna, aligned on the same geological structure; and a Neolithic miners’ settlement, Gawroniec, that received rough axes from the mines for finishing and polishing prior to distribution.

The Property dates from 3,900 BCE to 1,600 BCE (Neolithic to Early Bronze Age) and is the most complete and wholly readable socio-technical system of prehistoric underground flint mining and processing known in the world. Comprising over 350 hectares in total, it represents one of the largest complexes of its type, with publicly accessible excavations displaying evidence of the most advanced prehistoric mining technology manifest in the greatest morphological diversity of extraction features known. These include great chambers with a floor area of five hundred square metres or more that are unknown from any other site. Moreover, a unique type of flint was mined and traded in a verifiable radius of 650 km.

Flint is hard and durable, one of the most widely used – and the most important – raw material in prehistory, remaining as such for over half a million years. Flint is generally of a higher quality and more easily flaked when mined from underground, rather than surface-collected material that is sometimes flawed from weathering. It was extracted from underground seams and processed into tools by collective action. The specialized activity of flint mining, that is flint extraction via the digging of vertical shafts, required a high degree of technical competence and organization and is central to the Neolithic period in Europe.

Flint mines hold a special place in the history of technology. In particular, they are seen as the source of the mass-produced flint axe. This was an essential tool used to fell trees to make forest clearings and for shaping wood and making new types of houses, vital to increasingly sedentary communities that cultivated crops, domesticated animals and became more socially differentiated.

A substantial part of the value of the flint mined in prehistory may well have lain beyond merely utilitarian uses. Its aesthetic qualities, either through its colour or its patterning, and its provenance from deep in the earth, may have imbued the material with symbolic value, greatly enhanced when fashioned into artefacts and highly polished. Striped-flint, uniquely banded in exotic zebra-like patterns of alternating shades of grey, is only found in the Krzemionki area. A very large quantity from this deposit, with its distinctive quality of colour and pattern, was fashioned mostly into axes. Aside from being practical and functional tools, these were not things to accumulate but were also intended for exchange, to give and to receive. Sometimes Krzemionki striped-flint axes were unusually small, almost miniatures only a few centimetres long, recovered in the excavations of prehistoric graves many hundreds of kilometres away.

Ninety per cent of the known striped-flint outcrop was exploited in Krzemionki Opatowskie Mining Field, from two sub-horizontal beds or seams (0.7 to 3.0 metres apart) hosted in a synclinal deposit, part-parabolic in plan (20 to 200 metres wide over a length of 4.5 kilometres) and which dipped to the south-east. Bedrock geology descended into monolithic, hard and structurally competent
Jurassic limestone, as opposed to comparatively soft and friable Cretaceous chalk commonly associated with such mines elsewhere in Europe. The geological engineering situation demanded creative technical mining solutions that also favoured the survival of mine workings at variable depths and that differed distinctly in morphology and horizontal extent. The ensemble illustrates the greatest range of prehistoric flint mining techniques known in a single site.

The Krzemionki Opatowskie Mining Field contains over four thousand surviving pits and shafts, together with chambers, communication galleries and transport corridors. Five principal types of underground exploitation structures are represented: open-pit, niche-gallery, gallery, room-and-pillar and large chamber mines. The latter are unique, a pinnacle achievement in prehistoric flint mining, and the most complex reached a depth of nine metres, with single chambers ranging from 55 to 120 centimetres high and covering an area of as much as 500 square metres or more at distances up to 20 metres from the shaft. Each type occurs in different zones of the deposit structure and at different depths, and demonstrates the most appropriate, and highly developed, methods of flint extraction, the skilful management of output, and the regular design of safety measures. Simple tools – yet the widest range known from any prehistoric mine – were made of stone, flint, antler or wood, and in chamber mines a new tool was developed: a cigar-shaped, thick cylindrical flint pickaxe with a sharp point and blunt hammerhead, the forerunner of a traditional miners' pick.

Each mine type is also identified with different surface expressions in a remarkably intact anthropogenic surface that presents a rare Neolithic industrial landscape. This consists of shaft depressions and up-cast waste, remnants of flint workshops, miners' camps and communication routes.

Gawroniec Settlement, integral to the functional integrity of the deposit management system, is clear testimony to the organisation of a prehistoric community based around mining. It is a 'model' Neolithic settlement, located on a defensive steep-sided promontory with rich and fertile soil, and close to a water source.

Activity is predominantly associated with the Globular Amphora culture, together with the preceding Funnel Beaker culture and succeeding Mierzanowice culture. Market stimulation is responsible for the size and intensity of the exploitation of striped flint. There was no water available at the mines, and the soil was poor, so a permanent working settlement (Gawroniec) was established by the Funnel Beaker culture on high ground near the Kamienna River some nine kilometres to the south. This also served as the final processing site for shaping and polishing prior to distribution.

The easily recognisable provenance of Krzemionki striped-flint is unusual compared to other prehistoric flint artefacts, many of which, even today with advanced analytical techniques, are insecure in their provenance. Many finds of striped-flint axes occurred in the late nineteenth century, and their distribution began to be mapped as early as in 1917–18. This was before the discovery of the mines in 1922.

Between 1922 and 1939, efforts were made to protect Krzemionki Opatowskie as an archaeological reserve. The significance of the mines was soon found to be far more than regional when the distribution of polished striped-flint axes (functional and ritual) became identified in a radius of over 650 km from the complex, in present-day Germany, Czech Republic, Moravia, Slovakia, western Ukraine, Belarus and Lithuania. The Property’s cultural significance has become increasingly clear ever since.
3.1.b Criteria under which Inscription is Proposed (and justification for inscription under these criteria)

**Criterion (i)** represent a masterpiece of human creative genius

*Krzemionki prehistoric striped flint mining region* is an outstanding example of creative ability, providing clear testimony to early human inventiveness, mining techniques and organisation.

The network of mine shafts, galleries and chambers excavated in hard limestone illustrates the greatest range of prehistoric mining techniques evidenced in a single site. Using the most differentiated range of prehistoric mining tools known – of antler, bone, stone, flint, and wood – they adapted their mining techniques to the rock and the depth of the deposit, and skilfully managed organisation of extraction, output, waste management, transport, use of lighting and safety measures.

The prehistoric mining region is amongst the largest, most intensive and long-lived in the world, and its underground and surface evidence is, together, unparalleled. The intimately associated Neolithic settlement also presents a rare association that, of its type, size and known status as an axe-production site, is unknown in comparison with other sites.

The nominated Property is an exemplar of the Neolithic period which saw a transition from hunter-gathering to settlement and farming. The settlers needed tools to cut trees to clear the land, and to build houses. The Neolithic ‘mining phenomenon’ saw the creative development of a radically new principle of underground mining that allowed large quantities of better quality flint to be exploited from deeply buried seams. This allowed surpluses of production and extensive distribution and likely trade.

**Criterion (iii)** bear a unique or at least exceptional testimony to a cultural tradition or to a civilisation which is living or which has disappeared

*Krzemionki prehistoric striped flint mining region* is illustrative of the living and working patterns of settled prehistoric communities that distinguish the Neolithic period from that which preceded it. It provides exceptional scientific and anthropological evidence that supports a complete physical testimony of a distinctive cultural tradition that has disappeared. The value of the nominated Property, including the integral Gawroniec Settlement (also the region’s most significant
prehistoric settlement), is further enhanced by the proven distribution of striped-flint axes that have been identified in a radius of over 650 kilometres from the complex – the greatest recorded range for prehistoric flint axes as significant indicators of prehistoric movement.

*Krzemionki prehistoric striped flint mining region* bears exceptional testimony to the Neolithic cultural tradition of underground flint mining, a sudden ‘mining phenomenon’ that used a radically new principle of underground mining that allowed large quantities of better quality flint to be exploited from deeply buried seams. The organisation of extraction, production and distribution is represented by sites in the present-day United Kingdom, France, Belgium, the Netherlands, Denmark, Spain, Italy, Poland and Russia. The vast underground network and surface industrial landscape of pits and shafts at Krzemionki Opatowskie Mining Field, supplemented by the mining fields at Borownia and Koryczna, is the best exemplar of such activity.

Specialisation of flint exploitation (mining, flint knapping/axe making/polishing) appears at this time and the upland settlement of the Funnel Beaker culture (Gawroniec Settlement), located adjacent to a water source and on a loess promontory that represented good farmland, is characterised by 16 pits from flint workshops (over half being striped flint), an indication that flint was intensively worked here and that waste was carefully managed due to its dangerous nature to domestic animals and humans alike.

The continuity of mining activity spans two millennia, with a high level of mining competence developed and maintained for many generations. Three successive archaeological cultural units are represented: Funnel Beaker culture (c 4,300–2,800 BCE), succeeded by the Globular Amphora culture (c 3,400–2,800 BCE), followed by the Mierzanowice culture (c 2,300–1,600 BCE); the latter arrival marking the assumed transition between the Neolithic and Bronze Age in Poland. The most intensive mining phase is attributed to the Globular Amphora Culture, with 14C dates indicating a range from 3,400 to 2,900 BCE.

Intangible value of the mines is associated with economic aspects and an additional layer of social and ritual values. The large and deeper chamber mines were created by harder and more dangerous work than any other occupation at the time. Some walls in the extensive underground system contain isolated charcoal drawings, presently interpreted as coded information or an expression of a magical system and symbolism related with the beliefs of the Neolithic population. The distribution of bifacial axe heads of polished striped-flint is identified in a funerary context in a multi-directional radius of over 650 kilometres from the complex, the greatest recorded range for prehistoric flint axes as significant indicators of prehistoric movement.

**Criterion (iv)** is an outstanding example of a type of building, architectural or technological ensemble or landscape which illustrates (a) significant stage(s) in human history

*Krzemionki prehistoric striped flint mining region* provides exceptional evidence that the prehistoric period, which brought flint mining to produce tools, was a watershed period in the history of humankind. The organised ability to extract flint underground from hard rock
and process it in a collective and specialised manner represents a breakthrough in human technological and intellectual development. The production of flint tools changed everyday life to a great extent and contributed to the development of civilisation. It is probably the only craft represented by a complete socio-technical ensemble, from procurement to distribution, something almost impossible to assess for other aspects of the prehistoric economy.

The outstanding prehistoric industrial cultural landscape surpasses other flint mine complexes from the period and in the same geo-cultural region in the extent and diversity of evidence for advanced mining techniques and of the rare and substantially intact survival of flint-knapping floors (workshops) at the mines together with a settlement site where axes were finished and polished before being widely distributed.

Five principal and clearly distinguished types of underground structures survive in a stable condition: open-pit, niche-gallery, gallery, room-and-pillar, and chamber mines. These differ in depth and methods of flint extraction. Primary workshops, their remnants still visible close to over 4,000 shafts and pits, formed an integral part of each mine and are well preserved at each of three exploitation fields of Krzemionki Opatowskie, Borownia and Korycizna.

As a whole, the nominated Property presents a prehistoric industrial system with exceptional functional integrity and clear legibility. The potential for further discoveries is enormous.

**Significance and Attributes**

*Krzemionki prehistoric striped flint mining region* is internationally regarded as one of the largest and most significant prehistoric mining regions in the world. Krzemionki is also the foremost Neolithic monument in Central Europe. In terms of how Outstanding Universal Value, attributes include:

**Significance and attributes**

1. The most diverse range of prehistoric mine types (Krzemionki Opatowskie Mining Field: ‘chamber mines’, ‘pillar-chamber mines’, ‘gallery mines’, ‘niche-gallery mines’, and ‘opencast pits’) that are testimony to the most advanced technology of sophisticated techniques, skills, tools, methods and processes of underground Neolithic flint extraction that are known from anywhere.

2. A singular limestone outcrop that underlies and unites the mining fields as the only source of exotic striped flint exploited during prehistory.

3. An unparalleled surface industrial landscape of Neolithic flint mining, possessing high functional integrity of the entire flint exploitation system of shafts, tips, chipping floors, temporary camps and permanent settlement.
4. The longevity/span of working of Krzemionki prehistoric striped flint mining region is the longest in the world. If we assume broadly continuous working from 3,900 to 1,600 BCE, the span represents probably well over 100 generations, with inter-generational specialised technical knowledge transfer across three cultures: Funnel Beaker, Globular Amphora and Mierzanowice.

5. Immense archaeological resource, studied intensively and in a shorter and more recent timescale compared to other famous European flint mines, yet already yielding exceptional and, so far, unique evidence.

6. Intangible attribute of clear organisational ability and planning of a deposit management system through the physical arrangement of mine shafts, galleries, chambers and waste (above and below ground) in Krzemionki Opatowskie Mining Field.

7. Intangible attribute of distinctive product provenance (striped flint, and two typologies of axe) historically mapped (since 1917–18) in a pan-regional distribution of over 650 km radius from the complex, in present-day Germany, Czech Republic, Moravia, Slovakia, western Ukraine, Belarus and Lithuania, thus serving as an indicator of prehistoric movement and activity, including likely exchange and trade.

8. The widest recorded range of prehistoric mining tools recorded from any mine: made of stone (the only European Neolithic flint mine with tools made from igneous/volcanic rock), flint, antler, bone and wood, and including a rare tool type recovered from the chamber mines that indicates the development of a new specialist tool – a cigar-shaped, thick cylindrical flint pickaxe with a sharp point and blunt hammerhead, the forerunner of a traditional miners’ pick.


The majority of attributes are manifest in a range of physical elements that represent extraction (underground and surface, including between 4,000 and 5,000 shafts and pits), deposit management (underground and surface), processing features, and social infrastructure. This survives in an unparalleled state of conservation and accessibility, is subject to full legal protection, and is well managed. The Kamienna River, and its valley plain, likely played a significant role in prehistoric times as a source of fresh water and in communications, and it is important today as setting contained in buffer zone.

The assignment of dates to archaeological evidence is obtained through a combination of pottery artefact finds in all component parts (pottery styles are used to largely define prehistoric cultures from the Neolithic period onwards) and carbon dating of organic materials such as wood/charcoal/antler from Krzemionki Mining Field and Gawroniec Settlement. Samples of charcoal from Borownia, obtained in 2017, will be dated by 2018, and it is intended to do the same for Koryczna in 2018–19.
3.1.c Statement of Integrity

*Krzemionki prehistoric striped flint mining region* comprises the best preserved, most technically diverse and complete prehistoric flint mining assemblage known. They represent the main deposit of the Magonie-Folwarczysko Syncline, the only deposit of striped flint to be mined in prehistory.

The stratigraphic position of striped-flint, the location of its outcrops and of its prehistoric exploitation is precisely known and defined. All elements necessary to express potential Outstanding Universal Value are included in the serial site. It comprises well-preserved networks of three exploitation fields (one accessible underground) together with an anthropogenic topography that together illustrate the entire functions of the technological process from the underground extraction of raw flint through rough processing and polishing as the final product (predominantly axes) in both temporary and permanent settlement sites.

The established archaeological site boundaries of the four component parts that comprise mining fields contain all principle attributes of mining and processing in a remarkably intact state due to the high structural competence of lithology (hard limestone as opposed to more common softer chalk) and the intensely pitted mining fields being unsuitable for agriculture and having been ancient woodland. Principal features and attributes have been confirmed in detail using a combination of historic and recent archaeological research, including Airborne Laser Scanning that has accurately mapped the sites in 3D under forest cover. The permanent settlement site, on a promontory in open agricultural fields, was archaeologically excavated in the late-1940s and '50s and the boundary exceeds the archaeological site boundary that contains all known evidence of prehistoric settlement.

In terms of functional integrity, the nominated Property is exceptional. The entire process of prehistoric flint mining is represented: the largest and most technically diverse known underground mining network (with the longest span of working known from prehistory), together with its prehistoric surface 'industrial landscape', and proven directly associated settlements. Further, the production of the mining region is accurately provenanced through the distinctive and unique type of flint which has been detected in axes in grave goods for hundreds of kilometres from the source.

The site does not suffer from current adverse development or neglect. However, around 1920, local quarrying of limestone breached and indeed destroyed around 2.5 per cent of the prehistoric shafts and chambers in the deeper section of Krzemionki Opatowskie Mining Field (as many as 100 shafts). Whilst quarrying ceased after purchase of the Property 1928–32, and this activity has been forbidden since 1945 when the mines were created a Monument and Reserve, this area of modern workings is preserved and publicly accessible as part of the presentation of the full history of the site.
3.1.d Statement of Authenticity

*Krzemionki prehistoric striped flint mining region* is characterised by an exceptional level of authenticity, in all its attributes. This concerns, above all, the perfectly preserved form and design of underground structures such as shafts, chambers, communication galleries, transport corridors, supporting pillars or waste heaps of mining and processing, as well as the aboveground industrial landscape consisting of shaft depressions and up-cast waste, remnants of flint workshops, miners’ camps and communication routes.

The form and scale of the mining fields is highly authentic, being proven by a variety of archaeological investigations, including advanced geophysics and Lidar. The lack of further mining after abandonment in the Bronze Age has left the mining fields incredibly authentic to the Neolithic and Early Bronze Age; the dramatically disturbed landscape further remaining unsuitable to agriculture for successive millennia.

The majority of the mining fields are left unexcavated. At Bobrownia Mining Field the first excavations have been made in 2017 and at Korycizna Mining Field the first is planned for 2018. At Krzemionki Opatowskie Mining Field, a small segment of the mining field has been excavated archaeologically and, after some conservation work, made available to visitors. The underground visitor route, accessed via shafts, gives unparalleled access to workings with a diversity and combination of attributes that have remained almost unchanged for over 5,000 years, providing an unforgettable experience and educational opportunity to explore, directly, the perfectly preserved material traces of everyday life of prehistoric European communities.

The immediate settings of the mining fields at Krzemionki Opatowskie, Borownia and Korycizna are, albeit with an evolved landuse, broadly authentic with the type of cover and use.

Attributes of Gawroniec Settlement are equally easily read in terms of location and setting, form, and archaeological evidence that is tangible proof of organisation and process directly tied to the mining fields. Archaeological excavations were conducted between 1947 and 1961 and apart from extensive waste from flint processing, dateable evidence included pottery (large storage vessels, funnel-shaped flasks and vases, ceramic pipes, and ceramic weaving spindles) and organic remains which were radiocarbon-dated to between 3,500 and 3,200 BCE. New, additional and higher resolution, radiocarbon dates for the mining fields are being compiled during 2017–2018.

**Dating of Component Parts**

The origins of striped flint mining in the Krzemionki Opatowskie Mining Field must necessarily be approximate due to the size of the property, the state of research (including radiocarbon dating) and the limit of sampling that is confined to a comparatively small fragment of the
component part. From a combination of radiocarbon dates and pottery styles, commencement of the operation of the mines can be dated to the second half of the 4th century BCE, and their cessation to the second millennium BCE, probably ca. 1600 BCE. Further dates from charcoal samples from shaft no. 4/606 will be obtained in early 2018. Dating of the Borownia Mining Field, in light of the latest state of research (2018), is 2300-1500 BCE (from the end of the Neolithic period to the first periods of the Bronze Age). Dating of the Korycizna Mining Field will be conducted in the same manner as for Borownia Mining Field, but this dating is the most ‘approximate’.

Radiocarbon dating of Gwroniec Settlement shows that it was essentially a mono-cultural settlement inhabited between 3,500 and 3,200 BCE.

The Krzemionki Prehistoric Striped Flint Mining Region has also – what is very important – outstanding value as a cultural landscape, as it contains extremely-well preserved remains of morphology of the terrain, being result of the long-term exploitation and processing of flint. /…/ All the three pillars of the Outstanding Universal Value, expected and required in case of properties nominated to be inscribed in the World Heritage List, are present in case of the Krzemionki Prehistoric Striped Flint Mining Region.

Professor Zbigniew Kobyliński
Director
Institute of Archaeology
Cardinal Stefan Wyszyński University in Warsaw
3.1.e Protection and Management Requirements

Historic mines, including underground excavations, are considered to be industrial monuments and may therefore be subject to legal protection. The series *Krzemionki prehistoric striped flint mining region* is under full legal protection in its entirety.

The current legal system for the protection of cultural heritage in Poland is based on a number of rules contained in both domestic and international regulations. The most important piece of legislation in this regard is The Protection of Monuments and the Guardianship of Monuments (2003). This, along with implementation acts issued on the basis thereof, constitutes the fundamental source of law on the protection of historical monuments. It is on the basis of this act that subsequent entries into the Register of Monuments were made by government authorities on the regional level (Regional Monuments Inspector). The register, in force on a continuous basis since the Regulation of the President of the Republic of Poland on the Guardianship of Monuments (1928), provides the primary form of protection.

An immovable monument of outstanding cultural value that has been entered into the Register of Monuments may be considered as a Monument of History on the basis of a regulation of the President of the Republic of Poland. Krzemionki is among a total of 60 monuments that have so far been accorded this status, which further permits them to be considered as candidates for nomination to the World Heritage List.

The management system for *Krzemionki prehistoric striped flint mining region* is implemented by the ‘Krzemionki’ Archaeological Museum and Reserve (Muzeum Archeologiczne i Rezerwat ‘Krzemionki’) – a local museum that is renowned in Poland – who take a lead role in the management and protection of Krzemionki Opatowskie Mining Field. The system focuses on the protection, conservation, presentation and operation of the site and is shaped in relation to World Heritage pragmatics expressed in policy papers and Operational Guidelines for the Implementation of the World Heritage Convention, and as part of the legal system for the conservation of historic monuments and the mining law as regards historic mines. The management system, and its organisational structure, will be adapted and extended to the other three component parts in the series as part of a new Property management plan process currently (2018) in development and which will be adopted in that year.

Currently there are no recognisable threats or vulnerabilities to the preservation of the site for future generations.
Figure 169. Kamienna River near the Borownia mine (author J. Lech).
Justification for Inscription
3.2 Comparative Analysis

*Krzemionki prehistoric striped flint mining region* is one of the world’s longest-lived, most technically advanced and diverse prehistoric flint mining ensembles, with unparalleled preservation of functional integrity, and access, both underground and at surface and, moreover, which exploited a globally rare flint type that was distributed in a radius of 650 km from the site.

Comparison to the single close comparator on the World Heritage List (Spiennes) and to potential nominations to that list (state party tentative lists, and other selected potential properties) confirms that there is clear justification for *Krzemionki prehistoric striped flint mining region* to be placed on the World Heritage List.

Comparisons with *Krzemionki prehistoric striped flint mining region* have been made with a number of prehistoric flint mines in Europe, where shaft mining is limited, the development of sophisticated extraction techniques more limited, and even the survival of upstanding earthworks rare in continental Europe due mostly to heavy cultivation (their survival is better in the UK). Comparisons have also been made with sites elsewhere in the world.

The *Neolithic Flint Mines at Spiennes (Mons)* inscribed as a World Heritage Site in 2000 under criteria (i), (iii) and (iv), is a similar size but markedly different in terms of technology (narrow, but deep, shafts with short galleries, some with pillars), of flint type, and in terms of functional integrity of the entire socio-technical system, notably the Neolithic anthropogenic surface of pits and mounds, chipping floors and temporary camps. So too are the other principal significant mines of this typology, including Grime’s Graves and Cissbury (UK) and Rijckholt-St Geertruid (the Netherlands, which is similar to Spiennes), which are much smaller mining fields, mined a category of flint that is very different in colour (and difficult to determine distribution due to similarities with other flint localities), and they do not have a diverse morphology of extraction features, being limited to shafts and galleries (some with pillars) and not the expansive chambers encountered in Krzemionki. Shafts at the impressive site at Cissbury are filled, but there is potential to excavate.

Comparisons were made between *Krzemionki prehistoric striped flint mining region* and other sites, in the following categories:

A. Relevant World Heritage Sites
B. Relevant Tentative List Sites (2017)
C. Relevant, selected, global prehistoric flint mine sites
D. Prehistoric flint mines in Poland (National Comparative Analysis, and justification for the series)

*Figure 170.* Underground in a new excavation at Petite Spiennes in 2016 – collaboration in comparative analyses with scientific staff of Spiennes, Belgium (author B Gamble).
Methodology

An initial systematic scoping exercise considered a large number of properties in order to exclude those listed properties that are entirely different, and to isolate those that have an appropriate relevance in terms of like-for-like comparisons. More detailed comparisons were made with properties that share specific related attributes and express similar values to the nominated Property, with additional scrutiny being applied in instances of shared typological and chronological-regional provenance. These are presented here as direct comparators within the four categories, A to D, as listed above.

Significance and attributes were first considered and listed for *Krzemionki prehistoric striped flint mining region*:

- The present-day setting is generally one of an open and gently undulating landscape of fields and forest. The latter land-use (in which almost all the exploitation fields are set) has favoured the preservation of prehistoric anthropogenic topography thus far, but needs to be considered in the light of new protective measures.

- Temporary (weeks/months) camps are thought to have been set up at and around the mining field and, during the period of the Funnel Beaker culture, a permanent (more than 100 years) settlement was established just south of the Kamienna River on a promontory called Gawroniec hill, part of a wider loess upland where the soil for crops was favourable, and which overlooked a fresh water supply in steep ravines. In prehistoric times, the location was likely substantially cleared of woodland (which was in demand for timber and firewood), and no water was easily available at the main Krzemionki Opatowskie Mining Field and Korycizna Mining Field (Borownia Mining Field was close to the Kamienna River).

- The Property is a serial nomination with high compositional integrity, the best mining fields of the whole geological structure (syncline) being included, together with the settlement that was associated with them and where finishing and polishing axes took place.

- The size and shape of the complex of Neolithic flint mines, firstly in the Krzemionki Opatowskie Mining Field, is exceptionally distinctive: at over 311 hectares it is one of the largest known in Europe (Spiennes, only, is comparable) and has a most unusual exploitation pattern in that it follows a part-parabola in plan, over 4 km long. It is a vivid example of the intense and sustained prospecting and mining of a very significant flint type limited by a geologically structurally controlled deposit that dictated a range of mining techniques.

- Sophisticated and organised mines: a network of pits and vertical shafts, up to 9 m deep and over 4,000 in number developed over a long period of time (with shaft collars being comparatively wide at surface, approximately 3 metres), connected to an exceptional range, size and form of horizontal galleries and chambers; the so-called ‘chamber mines’ being the most developed of all Neolithic extraction features where no ‘wall’ of flint remained around their circumference and which in the largest cases attained a floor area that exceeds 500 $^2$. This is unparalleled in any other prehistoric flint mine in the world (the majority having galleries, only, that radiate from the base of shafts, with a minority of small pillar-chambers).
• The underground technical ensemble comprises: niche-gallery mines, gallery mines, pillar-chamber mines, and chamber mines, each at different depths and demonstrating the most appropriate methods of flint extraction as influenced by engineering geological conditions, skilful management of output, and development of safety measures.

• A Neolithic anthropogenic industrial landscape survives directly above the outcrop of the parabolic deposit at Krzemionki, the variable but distinctive surface features reflecting corresponding phenomena underground as prehistoric miners worked the heterogeneous deposit. At the other two mining fields, Borownia and Koryczna, this surface is also well preserved; at Borownia this is in an even better state of conservation than Krzemionki – being almost certainly the best preserved in Europe – but at Koryczna it is less well preserved than Krzemionki, though important nonetheless as surface investigation indicates intensive exploitation during the Early Bronze Age. The surface features of the latter two mining fields indicate accompanying relatively deep underground extraction.

• There is a distinctive spatial resource relationship between mining fields, workshops, temporary camps and permanent settlement; the latter located on a loess promontory that favoured farming, had the availability of adjacent potable water in ravines, yet still was not too far from the mines with a transport corridor available in the Kamienna Valley. This combination illustrates a classic prehistoric pattern.

• The raw material was primarily globally rare, unique in prehistory, ‘striped flint’. A substantial part of the value of the flint mined in prehistory may well have lain beyond merely utilitarian uses. Its aesthetic qualities, either through its colour or its patterning, imbued the material with deep symbolic value, which was greatly enhanced when fashioned and highly polished into artefacts. Exotic striped-flint, banded in zebra-like patterns of alternating different shades of grey, is unique to the Krzemionki area in prehistory. Its specific combination of colour and pattern was a quality, it seems, invested with significance. In archaeological investigations, its provenance is easily traceable when encountered in grave goods or other archaeological contexts elsewhere, enabling trade patterns to be mapped even before the mines themselves were first recognised.

• Hard limestone host rock – as opposed to softer chalk, or weakly consolidated strata – prompting the development of technically advanced underground extraction, and allowing a (so far) unique extraction chamber type, and its survival. In addition, Krzemionki represents the most differentiated tools of any Neolithic flint mine: including antlers of different animals (elk, red deer) as picks and scrapers, bone tools, flint pick heads, stone pick heads, prepared stone hammers. It is the only Neolithic flint mine were volcanic rock has been used for tools, and to cope with the variable hard limestone a special tool was developed with a flat hammer end and a pointed pick end – the forerunner of the modern miners’ pick.

• Exploitation of striped flint for axes (including very small ones of a few centimetres), chisels (rare, found in graves), some flakes, and (extremely rare) regular blades. Rough-outs have been found in the mining fields, whilst polished axes have been found as grave goods.

• The use of the exploitation fields (Krzemionki, Borownia and Koryczna) by three successive cultures, as indicated by finds of pottery and of flint in settlement contexts in the region,
3. Justification for Inscription

includes phases in the Middle and Late Neolithic and the Early Bronze Age: Funnel Beaker communities from approximately 3,600/3,500 to 2,800 BCE; Globular Amphora communities from approximately 2,800 to 2,200 BCE; and Mierzanowice communities approximately 2,200 to 1,800 BCE.

• Radiocarbon dating, providing striped flint exploitation chronologies of use (37 have been obtained from Krzemionki Opatowskie Mining Field) from around 3,400 to 2,600 BCE

• The nominated Property has high functional integrity and demonstrates the entire socio-technical flint exploitation system of Neolithic mining by shallow pits, underground shafts, galleries and chamber extraction, with sophisticated underground organisation.

• The nominated Property illustrates an exceptional ensemble of the greatest range of prehistoric flint mining techniques known in a single site. These are evidenced by distinctive mine types that differ in depth, morphology and horizontal extent, and are supported by processing floors/workshops (primary and secondary), and temporary/permanent camps.

• Tradition of temporary camps close to karstic depressions (lined with clay and that retained water; later levelled by farming but now part of the protected area) 200 to 500 metres south of the centre of the southern limb of the parabolic Krzemionki Opatowskie Mining Field. Mined flint was primary processed at flint workshop sites on the surface on the exploitation fields, and the nearby surroundings, and these comprise the richest heritage of this kind known in Europe; a rich archaeological resource that has been little studied. Finishing took place at the main site of Gawroniec Settlement.

• Extensive distribution network in a maximum radius of over 650 km, the greatest reach known for any prehistoric flint mine.

• Graffiti (some recorded and lost, some still extant).

• The meaning to prehistoric communities of deep underground mines, and flint sourced from them – particularly exotic striped flint that would have likely conferred a distinctive identity upon the miners.
The Property also has **high authenticity and integrity**. Krzemionki is amongst the top five examples of extensively researched and published prehistoric flint mines, worldwide. The site has high functional integrity with the prehistoric underground environment being exceptionally well preserved and its anthropogenic industrial surface intact. The inclusion of the miners’ settlement, where flint axes were finished and polished, is a rare association (Gawroniec Settlement is one of the most important Neolithic settlements in Poland). The **state of conservation is high**, until 1914 Krzemionki Opatowskie Mining Field was natural forest, and in 1922 protection was enhanced by the creation of a reserve, whilst Borownia has never been deforested and therefore never ploughed and (according to our knowledge Korycizna has been little affected). The site is funded as a Museum and a Monument, and **a high standard of protection and management** implemented by a local museum is based on longstanding protection as a Historical Monument of Poland and a Reserve of Archaeology and Nature.

### Summary of the comparison

<table>
<thead>
<tr>
<th>Name of property/country</th>
<th>Time frame BCE</th>
<th>Prehistoric industrial landscape</th>
<th>Settlement</th>
<th>Pits</th>
<th>Shafts</th>
<th>Galleries</th>
<th>Pillar chamber</th>
<th>Chamber</th>
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<tr>
<td>Krzemionki prehistoric striped flint mining region Poland</td>
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A. Comparisons Between the Nominated Property and Relevant World Heritage Sites

There is only one Property inscribed on the World Heritage List that may be regarded as a direct comparator to *Krzemionki prehistoric striped flint mining region*:

**Neolithic Flint Mines at Spiennes (Mons) (Belgium)**

**INTRODUCTION:** One of the early, most extensive and deepest concentrations of prehistoric flint mines known. Inscribed on the World Heritage List, these mines were first noted in the 1840s, through a combination of quarrying and landslides, and were famously exposed in 1867 by the cutting of the Mons to Bencke railway that exposed 25 vertical shafts. The complex of three mining fields is located on two principal plateaus separated by a river valley. At surface there has been a substantial loss of authenticity and integrity through longstanding agricultural use with repeated ploughing, and destruction through large-scale extensive collection of artefacts by farmers, antiquarians and collectors indiscriminantly digging over many decades during the nineteenth century indeed until the 1950s. The underground property, however, demonstrates deep shaft and extensive gallery networks in a richly preserved underground environment.

**YEAR OF INSCRIPTION:** 2000.

**GEO-CULTURAL REGION:** Europe.

**THEME:** Underground prehistoric flint mining.

**CRITERIA:** (i), (iii), (iv).

**MINERALS:** Flint (grey).

**TIME PERIOD:** Dating is given in the range 4,350 – 2,300 BCE (14C dates).
KEY VALUES AND ATTRIBUTES: One of the largest (covering over 100 ha), earliest (commencing around 4,400 BCE) and deepest (up to 16 m) concentration of ancient mines in the world. They represent the early period of the Neolithic flint ‘mining phenomenon’, though are not the oldest in Europe. The first archaeological discoveries were made from 1867, though prehistoric flint mines were suspected there in the 1850s; the discovery did much to encourage similar excavations in England (for example Cissbury and Grime’s Graves) and Continental Europe (for example Rijckholt-St Geertruid).

The complex of the mining field at Spiennes, whilst very different from Krzemionki, demonstrates a large differentiation of flint exploitation, from the very simple to the very complicated. Short horizontal galleries on the slopes, and pits and shallow shafts with niches, and deeper shafts with galleries on the higher ground. Radiating from the base of numerous shafts are niches and galleries, the larger and deeper ones exhibiting evidence of a particular mining technique well-known in Spiennes archaeology and termed ‘striking’: large slabs (up to 2 m long) were loosened underneath by picking away either side to leave a wall of chalk in the centre, then placing wooden props for support before knocking down the solid central wall and then striking out the props to allow the flint slab to collapse from the roof under its own weight. Neolithic man likely discovered the flint in an exposed context on the valley sides.

SIMILARITIES: Shafts, though narrower and deeper (0.8 to 1.2 m diameter and an average depth of 9–12 m and a maximum of 16 m) and with a higher density (as many as 5,000 in the Petite Spiennes zone of 14 ha). Flint picks were the principal tools, whilst Red deer antlers are also noted, together with stone (sandstone) hammers.

At Spiennes, Rijckholt-St Geertruid (and in Poland at Swieciechow), they used a different technique of flint treatment as compared to Krzemionki. They prepared a pre-core, a core then a blade, then an axe from the remaining core. At Krzemionki they mostly prepared axes. At Spiennes (and Rijckholt-St Geertruid) there was an important production of flint picks that were used during the digging of shafts and galleries as well as the extraction of flint nodules. Traces of a camp have also been discovered at the site comprising two irregular concentric pits situated on a plateau dominating the surrounding countryside, a settlement form characteristic of northwest Europe, together with settlement vestiges on the plain.

Effective protection at Spiennes is of a high standard, the site and mining structures being declared a Monument in 1991 and on the List of Outstanding Heritage of Wallonia – the highest level of protection foreseen in Walloon legislation. Inscription on the World Heritage List was achieved in 2000.

Effective management has been carried out since 2011 by a Steering Committee, a Scientific Committee and a Management Committee. The site has a new visitor centre, research facilities and retains high archaeological potential.

DIFFERENCES:
• Flint type of grey flint (the same as Rijckholt-St Geertruid flint from the Netherlands), which is very similar to other Western European grey flints, as opposed to the striped-flint of Krzemionki, making it impossible to attempt to map distribution from Spiennes; though it is assumed to have been distributed over a radius of some hundreds of kilometres, possibly in competition with Rijckholt-St Geertruid.
• 15 stacked flint seams; though most of these were not exploited due to their variable qualities) containing nodules of 10 to 30 cm in diameter and slabs between 1 and 2 m long and 0.5 m thick.
• The lithology is chalk (put horizon, Cretaceous Maast etc), like its well-known counterparts.
in the United Kingdom and elsewhere, as opposed to the much harder Jurassic limestone of Krzemionki.

• The engineering geological condition affected working methods, including the diameter, density and spacing of shafts, and strongly influenced the shape and dimensions of underground workings. Spiennes required numerous very narrow shafts (around 1 m), shorter levels/galleries (maximum 4 m from the centre of the shaft) and very small/short chambers (with prop/pillar system), as compared to Krzemionki where shafts might be 3 to 4.5 m in diameter and levels and chambers substantially larger – up to 500 or more square metres. The short levels at Spiennes are likely due to the engineering geology of the chalk that meant that they sought to be near the shaft for safety and stability reasons. The deepest shafts (up to 16m) access large (the largest 5 m x 10 m) but low (average 80 cm) galleries/chambers. In Petite Spiennes a miner could stand upright in some small chambers (unlike at Krzemionki) as they exploited several layers of flint (though not in large slabs as at Camp- à Cayaux Shafts 1.2 etc wide, with bell shape at bottom (not like Krzemionki)).

• The time period for Spiennes starts much earlier (is older) compared to Krzemionki (by around 1,000 years).

• Spiennes covers a larger area, over 100 ha in total, and comprises three mining fields with many more shafts than Krzemionki: Camp à Cayaux (65 ha, estimated 15,000 to 25,000 shafts) and Petit-Spiennes (14 ha, estimated 5,000 shafts) on opposite sides of the river Trouille, and ‘Le Versant de la Wampe’, adjoining the latter.

• The archaeological artefacts discovered in the Spiennes mines, together with the settlement forms, are characteristic of the so-called Michelsberg culture (4,400 – 3,500 BCE) that was present in the Middle Neolithic over a vast territory that includes large parts of Germany, Belgium and Northern France.

• Spiennes principally produced long and middle-sized blades as well as flake blanks (longest blades were a little over 30 cm), for scrapers, knives or scythes and axes, but not the finely polished axes in striped-flint (some just a few centimetres long) known from Krzemionki.

• Spiennes, unlike Krzemionki, has a highly degraded anthropic Neolithic surface relief. In World Heritage inscription documentation the Brief Synthesis of Outstanding Universal Value states: They cover an area essentially devoted to agriculture. The site appears on the surface as a large area of meadows and fields strewn with millions of scraps of worked flint. Mine shafts are filled (as are all such shafts) but extensive and prolonged ploughing means that traces of flint workshops have long been reduced to repeated widespread scatter, the area remaining zoned for agriculture. The re-exploitation of flint also took place during the nineteenth century for the manufacture of gun flints. A railway line cut through 25 shafts in 1867 and made the discovery widely known.

• Spiennes contains a large amount of pottery for this type of site (much more than Krzemionki) and abundant animal and human remains, which Krzemionki does not.

• Access underground is limited for conservation purposes to 12 people at any one time, and a maximum of 5,500 visitors per year. Carrying capacity underground is severely limited, and less-abled visitors are not able to access the underground, as compared to Krzemionki where its underground carrying capacity, and planned disabled access, can, through optimum maximum visitor numbers of circa 30,000, help to greatly enhance awareness and understanding of these internationally important monuments.
B. Comparisons Between the Nominated Property and Relevant Tentative List Sites (2017)

There are currently (2017) two prehistoric mines on State Parties’ Tentative Lists, although these cannot be considered as direct comparators because they were sites for exploiting completely different minerals (as compared to flint) for very different purposes (not for the production of tools), and one being exploited during a completely different period: variscite (a rare phosphate, sometimes confused with turquoise) exploited for jewellery during the Neolithic; and iron pigments exploited for paint, especially pictographs, and likely for personal use, exploited during the Palaeolithic. These sites are included, however, in order to clearly understand their justification of non-relevance.

Neolithic Mines of Can Tintorer en Gava, Catalonia (Spain)

**INTRODUCTION:** *Neolithic Mines of Can Tintorer en Gava* is located near Barcelona and, although not a flint mine, it dates to the Neolithic era and comprises an underground environment of shafts and galleries from where the lustrous green mineral variscite was mined for trading as jewellery, an important aspect of Neolithic studies. This property, first archaeologically excavated from 1978, is registered in a general list of ‘mining’ and is likely to be considered for nomination as a single property, as have previous sites on this list.

**GEO-CULTURAL REGION:** Europe.

**THEME:** Prehistoric mines.

**MINERALS:** Green-coloured variscite.

**TIME PERIOD:** 4,200 to 3,400 BCE, with their apex during the Middle Neolithic in the Catalan Culture of Sepulcros de Fosa.

**KEY VALUES AND ATTRIBUTES:** Variscite was mined for making jewellery, the site comprising...
3. Justification for Inscription

A significant archaeological site of the Mediterranean Neolithic. Variscite was used to make the necklaces commonly found inside Neolithic tombs along the Mediterranean and Atlantic coastlines of France and Spain.

**SIMILARITIES:** Mining methods conditioned by the mineral deposit and its structural nature and the engineering-geology of the host rock; underground Neolithic mining using shafts (to sink through overlying strata to reach a different underlying strata containing the desired mineral) and galleries; Trading network (although to various parts of the Iberian peninsula and France) verifiable due to viable provenance of the material.

**DIFFERENCES:**
- Mineral (variscite as opposed to striped flint);
- Host rock (palaeozoic calcareous rocks);
- Sub-vertical vein deposits as opposed to sub-horizontal, discontinuous, bedded deposits;
- Product (jewellery as opposed to tools).

**Ngwenya Mines (Swaziland)**

**INTRODUCTION:** This property is located in the mountainous northwestern border region of Swaziland. It is an iron-mining site worked in three principal periods: firstly, and anciently, for pigments (red oxide and specular iron) from at least 42,000 BCE; secondly for iron ore around 400 CE; and thirdly from 1964 to 1979 for iron ore by large-scale modern opencast mining.

**GEO-CULTURAL REGION:** Africa.

**THEME:** Prehistoric mines.

**MINERALS:** Iron ore (specular hematite and red hematite)

**TIME PERIOD:** 42,000 BCE, until recent.

**KEY VALUES AND ATTRIBUTES:** One of the world’s earliest sites of ancient mining activity, based on ancient iron ore deposits used for pigments. The principal feature of significance is ‘Lion Cavern’, a 10 m-long tunnel, 7 m high by 8 m wide, cut into the precipitous 150 m-high western cliff face. **In situ** may still be seen hematite (red ochre, Swazi name ‘libovu’) that was also used
by the ancestors of the present San (Bushman) peoples for the numerous pictographs to be found in Swaziland, and specular hematite (sparkling ochre, Swazi name ‘ludumane’). A second mine, ‘Castle Cavern’, dates from around 400 CE when agro-pastoralists, who also smelted iron ore, arrived from north of the Limpopo River. They extracted the ore using extremely heavy iron hammers and traded the iron widely throughout the region. The modern opencast iron mine opened in 1964 and acted as a catalyst to industrial and economic development in Swaziland (a railway line and electricity lines were established, and the Matsapha industrial area was developed as a direct result of mining).

**SIMILARITIES:** Prehistoric underground mining (a similar mine, named Rydno, exists near Krzemionki, dated near terminal Palaeolithic/Mesolithic/Neolithic).

**DIFFERENCES:**
- Geocultural region;
- Mineral (iron ore, as opposed to striped flint);
- Product (pigments, and later iron ore, as opposed to tools);
- Level, as opposed to shaft mining.
- Tools of dolerite (‘choppers’, picks and hammerstones) as opposed to antler and flint.
- Modern opencast mining, with unknown consequences on the prehistoric environment;
- Government contemplates to restart mining.
C. Comparisons Between the Nominated Property and Relevant, Selected, Global Prehistoric Flint Mine Sites

Over 150 prehistoric flint mining centres are known throughout Europe. Four examples comprise the most well-known, researched and published: Spiennes (Belgium), Cissbury and Grime’s Graves (United Kingdom), Rijckholt-St Geertruid (Netherlands), and Krzemionki (Poland, the nominated Property). Whilst these are the closest comparators, some further selected Neolithic flint mines have been illustrated as comparators, including: Harrow Hill, Church Hill and Blackpatch (South Downs group, United Kingdom), Jablines (France), Defensola (Italy), Casa Montero (Spain), Hov and Aalborg (Denmark), Ros (Belarus), Kvarnby (Sweden) and Grand Pressigny (France) the latter not an important mine but there are important chipping floors and it is highly significant for distribution.

Chert mining (underground exploitation) began in central Egypt in the Upper and Middle Palaeolithic. Palaeolithic mining also took place in Poland, in the vicinity of the Holy Cross Mountains and the Kamienna River. Underground flint mining developed among the early farming communities predominantly during the Middle Neolithic period, and continued at certain sites until the Bronze Age. The sinking of shafts and driving levels (galleries) to extract the flint deposits is a shared technology between these sites, but the following are frequently different: flint type, host lithology, size of exploitation field and type/technique of extraction, period of activity, flint processing techniques and products, settlement and evidence for distribution.

Grime’s Graves
(United Kingdom)
INTRODUCTION: Britain’s most famous prehistoric mine, and its most important Neolithic flint mine (one of only ten confirmed in England), with an iconic ‘lunar’ landscape (‘the hollows’) of 433 large shafts. The mines were identified by archaeological campaigns between 1868 and 1870 when shafts were excavated and radiating galleries off the base discovered together with important artefacts. This was shortly after the discovery and revelations in 1867 of the Neolithic flint mines at Spiennes in Belgium.

GEOCULTURAL REGION: Europe.

THEME: Underground Neolithic flint mining.

MINERAL: Flint (black, and unpatterned) in Cretaceous chalk.

TIME PERIOD: 2,650 – 2,100 BCE (Late Neolithic and the Bronze Age) with a second phase between 1,550 and 1,450 BCE (Middle Bronze Age). This is chronologically distinct from other British Neolithic flint mines, which are much older, possibly starting even earlier than 4,000 BCE.

KEY VALUES AND ATTRIBUTES: ‘The hollows’, an impressive strange undulating landscape of infilled shafts and pits, first given the name of ‘Grim’s Graves’ by the Anglo-Saxons (meaning the quarries of the pagan god Grim or Woden). This surface grassland, devoid of trees (cut from the mining field in the 1960s), is impressive, all the more given the large diameter of shaft collars and the large number. This is the only Neolithic flint mine in Britain where visitors may descend a shaft (number 1 shaft) and view into the underground flint extraction galleries (a second shaft, Greenwell’s, is open to the public from 2017).

SIMILARITIES: Overall, late-Neolithic to Bronze Age underground flint mine to Krzemionki, and Spiennes. End Neolithic in England is later than the termed period in Poland (where it would be Early Bronze Age).

Flint workshops are in the mining field and close to its border (but we are not sure if they are contemporary with the shafts) as there is a rapid fall-off in the density of struck flint around 200 m from the shafts. Grime’s Graves is open to visitors, including the descent underground of one shaft where visitors can view into the extraction chambers that radiate from it. Greenwell Shaft opened to the public for special tours in 2017. It is the only underground Neolithic flint mine accessible to the public in Britain.

DIFFERENCES:
• Flint (black) that is similar to several English mines (cannot distinguish in mapping distribution);
• As with all English mines, the mining field is comparatively small (7.6 ha), an area dwarfed by Krzemionki;
• 433 shafts, around 10 per cent of the number at Krzemionki (Krzemionki much bigger than any English mining field);
• Shafts extend to a depth of 12 metres, significantly deeper than those at Krzemionki, and they are generally, and notably, much wider at surface, commonly 12 to 15 metres in diameter. In an exceptional case, a slightly oval depression measures 22 m by 20 m (currently 2.3 m deep). Some shafts are ‘paired’. Shafts are the result of different lithology and engineering geological conditions when compared to Krzemionki, a different organisation of labour in which perhaps up to ten miners worked together. The large-scale organisation and intensity of mining perhaps at Grime’s Graves indicates the demand for much more flint than at Krzemionki;
• Beyond galleries (extending up to a maximum of 16 m from the shaft, and some with pillars, as in other English mines), there does not appear to have been any further technical developments of mining techniques, certainly none to match those illustrated by the large and extensive chambers developed at Krzemionki;
• No related settlement determined;
• Carrying capacity underground is severely limited, and less-abled visitors are not able to access
the underground, as compared to Krzemionki where its underground carrying capacity, and planned disabled access, can help to greatly enhance awareness and understanding of these internationally important monuments.

Rijckholt-St Geertruid, Limburg (Netherlands)

INTRODUCTION: This 8-ha underground mining field, with an overall site of around 25 ha containing flint debitage, is located 6 km SSW of Maastricht near the Belgium border. It is located on a slope and the edge of a plateau on the eastern side of the Meuse Valley, and comprises around 2,000 shafts. The site was discovered as a flint workshop site around 1884–5, the flint mine being later recognised in 1904–05 and excavated from 1923 to 1925, and extensively excavated from 1964 to 1972. It is a smaller, but very similar site in flint type, exploitation period date and in technical attributes to Spiennes in Belgium, some 200 km distant.

GEOCULTURAL REGION: Europe.

THEME: Underground Neolithic flint mining.

MINERALS: Flint, dark grey, in Upper Cretaceous chalk.

TIME PERIOD: (3,950 BCE, rare), with principal exploitation phase from 3,300 to 2,450 BCE (from recent 14C dates).

KEY VALUES AND ATTRIBUTES: Underground property of around 8 ha that contains around 2000 shafts, each typically around 1 m diameter. Some shafts are paired, and connected underground by galleries and narrow passages, possibly for reasons of safety (escape) and for ventilation.

SIMILARITIES: Time period. Underground shafts and galleries. Flint picks were the main tools, and also more rare antler picks. Main product semi-finished or polished bifacial flint axes (oval cross-section), blades, chisels and flakes. Mined flint of the Rijckholt type is found in Lower Saxony and Hesse (300 km away) and Baden (over 500 km away).

Differences:
• Flint type relatively standard (grey, similar to Spiennes flint), very different to the special striped flint of Krzemionki;
• Lithology – (geological age) chalk (as opposed to Jurassic limestone at Krzemionki);
• Narrow (1 metre) and deeper shafts (up to 12 metres);
• Flint extracted from the middle of galleries. Shallow pits. Lack of the most developed system of extraction (chamber as at Krzemionki);
• The widespread use of flint picks (14,217 flint picks, 216 flint hammer-stones both ‘hard’ and ‘soft’ with (variations in silica in chalk), and some rare antler picks);
• Access is via 150 m-long modern horizontal tunnel;
• Principally operational by Michelsberg culture (based on volume of pottery found), but beginning of mining is probably earlier, followed by the Stein group;
• Access underground is strictly limited for conservation purposes (archaeological and bats). Krzemionki, in comparison, has a high underground carrying capacity, planned disabled access, and can, through potential visitor numbers of circa 30,000, help to greatly enhance awareness and understanding of these internationally important monuments.

Cissbury, Harrow Hill, Church Hill and Blackpatch (United Kingdom)

INTRODUCTION: This is the eastern cluster of Neolithic flint mines on the South Downs (known as the Worthing Group). They are located on the rolling hilltops of steep downland capped by clay-with-flints in Cretaceous Sussex white chalk (6 out of 10 English Neolithic flint mines are in Sussex). The sites are roughly equidistant, separated from each other by around 2 km; the terrain being so intractable that it was not cultivated and supports a different type of vegetation. The mines are much older than Grime’s Graves. Cissbury was the first prehistoric flint mine to be excavated after the discovery at Spiennes in Belgium which influenced similar activity in England.

GEOCULTURAL REGION: Europe.

THEME: Underground Neolithic flint mining.

MINERALS: Flint in Cretaceous chalk.

TIME PERIOD: Cissbury 4,000 to 2,900 BCE, Harrow Hill 4,000 to 3370 BCE, Church Hill 4,490 to 3,810 BCE, and Blackpatch 4310 to 3530 BCE.

KEY VALUES AND ATTRIBUTES: Cissbury, possibly containing around 270 shafts, and Harrow Hill
(around 160 shafts) retain substantial earthworks (rare at such flint mines in Europe), and are associated with later, dramatic, archaeology: Cissbury Ring (Middle Iron Age c 250 BCE, one of the largest in Europe), and a late Bronze Age enclosure on Harrow Hill, both in intimate spatial association with the flint mines, and further supplemented by Celtic field systems. Church Hill (probably containing around 29 shafts), and Blackpatch (around 20 shafts), have suffered from prolonged ploughing and some bulldozing.

**SIMILARITIES:** Underground shaft with galleries (and some pillars). Remnants of flint workshops have been excavated around the shafts at Cissbury.

**DIFFERENCES:**
- Flint type (black, as opposed to striped grey of Krzemionki);
- Host rock (softer chalk as opposed to hard limestone of Krzemionki);
- Beyond ‘galleries with pillar’ workings, as in any English mine, there does not appear to have been any further developments of mining techniques, certainly none of the large and extensive chambers noted at Krzemionki;
- There is no associated contemporary settlement, although this is thought to be more likely located on lower ground in the coastal plain;
- ‘Celtic’ field systems have partly obscured the flint mining surface at Cissbury (inside an Iron Age hillfort that has also created an artificial boundary to the mines) and at Harrow Hill (where there is a later enclosure on the summit) and Blackpatch;
- Church Hill has only slight earthworks remaining, as it was intensively ploughed in the 1950s. This still continues;
- Blackpatch has only slight earthworks remaining, as it was bulldozed by the War Ministry in the 1940s and subsequently ploughed.

### Jablines, Seine-et-Marne (France)

**INTRODUCTION:** Located 30 km east of Paris, this is an 18 ha (overall) site that was recognised as a Neolithic flint mine in 1981. It was excavated in 1989–90, in a very limited time, in advance of TGV railway construction when 766 shafts (located in 3.5 ha) were threatened. Excavation and rescue archaeology was difficult and dangerous due to the poor stability of the ground (plastic limestone-marl). A settlement was found close by.

**GEOCULTURAL REGION:** Europe.

**THEME:** Underground Neolithic flint mining.

**MINERALS:** Flint/chert (Paris Basin Bartonian) in St-Ouen limestone-marl (‘plastic’).
TIME PERIOD: 4,284 to 3,495 and 3,100 to 2,800 BCE.

KEY VALUES AND ATTRIBUTES: Distinctive and diverse morphology of extraction features. The surface diameter of pits and shafts is always quite small (1.2 to 2 m), with simple extraction pits being around 1.5 m deep, vertical pits around 2 to 2.2 m deep with extraction niches halfway down, and bell-pits with a vertical section 1 to 1.5 m deep, the base of which is worked in all directions forming the shape of an inverted cone. Some shafts (in the southern zone) are from 4 to 7 m deep with diameters of at least 2.5 m. Galleries (maximum height 70 cm) radiate off the shafts and vary in length from 1.5 to 7.5 m. Narrow passages frequently link the galleries to one another.

SIMILARITIES: Classification as a limestone host rock (though very different properties). Flint nodules extracted from the floor by working loose with leverage, and from the ceiling by undermining, and the extensive use of antler picks. Axes as product, with debitage next to, and infilling, shafts.

DIFFERENCES:
- Flint type;
- Limestone is a 'plastic marl', very unstable with collapses occurring during excavations;
- Much smaller exploitation field;
- Flint type (very similar to a number of other French mines), so also difficult to trace distribution;
- The time period begins much earlier (much older) than Krzemionki (it is more contemporary with Spiennes);
- Narrow shafts (commonly 1.5 m, maximum 2m wide) that extend to a depth of 7.5 m, maximum;
- Galleries 1.5 m to maximum 7.5 m long (with narrow passages linking), but no chambers;
- Integrity was reduced when around 20 per cent of the site was destroyed by the course of a new railway line (TGV) in the 1990s (but it is still the best known excavated and published site in France).

Defensola, Puglia (Italy)

INTRODUCTION: There are over 20 known prehistoric mines located on the hillslopes of the Gargano promontory that juts out along the east coast of Italy. This is a very important site that was developed during the 6th millennium BCE at the beginning of the Neolithic. The mines,
mostly horizontal entries with extensive galleries, together with some shafts and small pillar-chambers, has been systematically investigated since 1981.

**Geocultural Region:** Europe.

**Theme:** Underground Neolithic flint mining.

**Minerals:** Flint / chert (brown-red), nodular, of excellent quality, in limestone (Eocene).

**Time Period:** 5,800 to 5,500 BCE.

**Key Values and Attributes:** Very early (beginning of Neolithic), older than all main comparators listed here. Trenches and horizontal developments of galleries more than 100 metres long with small chambers (some with pillars).

**Similarities:** Limestone host. Galleries, some with pillars. Flint picks recovered.

**Differences:**
- Mineral type – brown-red flint as opposed to grey striped flint;
- The time period begins much earlier (much older) than Krzemionki;
- Predominantly horizontal galleries with small chambers;
- No settlements discovered;
- Different culture.

**Casa Montero, Madrid (Spain)**

**Introduction:** The second oldest (after Defensola) Neolithic flint mine known in Europe and the earliest Neolithic mine known in the Iberian Peninsula. Around 3,794 cylindrical shafts have been recorded in initial studies that began in 2003. Not so important from the technological diversity of evidence, the mine contains simple shafts like many such mines in Europe.

**Geocultural Region:** Europe.

**Theme:** Underground Neolithic flint mining.

**Mineral:** Flint, with opaline outer and quartz inner parts.

**Time Period:** 5,300 to 5,200 BCE (charred oak and short-lived juniper from the mine with 14C dates of 5,200 to 5,300 BCE) and pottery fragments suggesting c 5,400 to 5,000 BCE.

**Key Values and Attributes:** Vertical, narrow (1 m wide) shafts, commonly over 5 m deep (0.6 to
over 9 m deep) and with minimal / almost no galleries / chambers, the shallower shafts (around 2.5 m) being more irregular and sinuous.

**SIMILARITIES:** Prehistoric underground mining but with shallow/narrow shafts.

**DIFFERENCES:**
- Ordinary flint (opaline chert) that lacks aesthetic qualities, as opposed to striped-flint something very specific);
- Miocene sediments of clay beds with dolomite and silica rocks, structurally less competent rock that required numerous narrow pits/shafts as opposed to striped-flint of Krzemionki hosted in structurally competent Jurassic limestone.
- Small site of 6 to 8 ha (4.2 ha excavated);
- Short operational life (hundreds of years only);
- Product was not axes but short blades of around 5 x 2 cm (and in less quantity bladelets);
- Site discovered because of a new M-50 motorway in 2003 was partially re-routed. Rescue excavation.

**Hov, Jutland (Denmark)**

**INTRODUCTION:** Discovered from 1957, shafts up to 3 m wide and 5 to 8 m deep with galleries (30 to 50 m² from each shaft), and elsewhere at Hillerslev with pits (1 to 1.5 m wide and 2 or 3 m deep) with the flint excavated from the shafts, only, and not from galleries.

**GEOCULTURAL REGION:** Europe.

**THEME:** Underground prehistoric flint mining.

**MINERALS:** Flint (grey) in Maastrichtien chalk.

**TIME PERIOD:** c 2,800 BCE and 1,800 BCE.

**KEY VALUES AND ATTRIBUTES:**

**SIMILARITIES:** Neolithic shaft mining for flint. Axes as the principal product.

**DIFFERENCES:**
- Flint type, ordinary (grey), as opposed to striped;
- Deposit hosted in softer chalk, as opposed to hard limestone;
3. Justification for Inscription

- Small deposit area;
- Limited morphology of extraction features – pits and shafts with galleries, but no large chambers as at Krzemionki;
- No traces of settlement.

**Krasnaselsky, Grodna (Belarus)**

**INTRODUCTION:** Located along the Ros River. There are trenches and bell-shaped pits, but also many shafts up to 1.5 m wide and 3 to 4 m deep (exceptionally 8 to 9 m), with 1 m long extraction niches (some with pillars and arched sides to the roof) extending from them, sometimes on two levels and sometimes inclined. Around 600 shafts were discovered in the 1920s, main excavations in late 1950s and 60s. 200 shafts were excavated, but only about 140 remain.

**GEOCULTURAL REGION:** Europe.

**THEME:** Open shafts and limited underground Late Neolithic and Bronze Age flint mining.

**MINERALS:** Flint, in chalk.

**TIME PERIOD:** 3,500 to 1000 BCE (Neolithic and Bronze Age).

**KEY VALUES AND ATTRIBUTES:** Flint, exploited by Middle Neolithic and all Bronze Age communities (and to beginning of Iron Age), from glacial deposited tongues and blocks of very pure white chalk (unique for central and eastern Europe).

**SIMILARITIES:** Prehistoric flint mining. Shafts, with niches and short galleries. Red deer (and moose) antler horn picks. Burnt charcoal to give good dates and charcoal spots on chalk walls. Axes were the main product, with workshops found on the outskirts of the deposit. Clear connection to Globular Amphora, Cordred Ware and Bronze Age communities including Trzciniec communities. Protection as an Archaeological Reserve, under the Ministry of Culture of Belarus (part, from 1964).

**DIFFERENCES:**
- Flint type;
- Chalk as opposed to limestone at Krzemionki;
- Limited morphology of extraction features.
**INTRODUCTION:** One of around 49 prehistoric flint and chert exploitation sites known in France. Famous for long flint blades, not axe production, its technical aspects of flint treatment important, but not as an interesting system of flint exploitation. Distinctive honey-coloured flint, although unlike the striped flint of Krzemionki, nonetheless had high aesthetic appeal. These flint blades found their way, prolifically, into the cabinets of museums and private collectors during the nineteenth century. The flint was worked in prehistory from shallow pits widely distributed across the region (not one single site, and not underground).

**GEOCULTURAL REGION:** Europe.

**THEME:** Neolithic flint extraction known from some shallow pits and no extensive mining field (not underground).

**MINERALS:** Flint (honey-coloured) in unconsolidated sediments.

**TIME PERIOD:** 2,240 to 2,180 BCE.

**KEY VALUES AND ATTRIBUTES:** Flint processing and distribution is significant: Famous long blades from specific cores, a very elaborate process.

**SIMILARITIES:** Distinctive flint enabled a 500 km distribution of dagger or knife blades to be mapped out (including Belgium and the Netherlands).

**DIFFERENCES:**
- Flint type (honey-coloured as opposed to grey striped);
- Unconsolidated sediment host as opposed to limestone;
- Pits, as opposed to shaft mines with galleries;
- Product was long blades (25 to 40 cm long) made by indirect percussion from specific large cores (known as livres de beurre);
- Lack of archaeological integrity in terms of sites.

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**Elsewhere in the world**

Beyond Europe and Eurasia, flint was mined in prehistoric and historical times in Egypt using shafts, and more commonly, quarries. In quarries and shallow opencast excavations chert and flint was commonly worked during prehistoric and historical times in many countries, for example: United States of America (limestone areas in central USA host abundant chert nodules that were worked in prehistoric times, for example large pits at Flint Ridge, Ohio, and Spanish Diggings, Wyoming); and in Pakistan (Jhimpir, Lower Sindh) and elsewhere.
D. Comparisons Between the Property and Prehistoric Flint Mines and Associated Settlements in Poland

National Comparative Analysis, and justification for the series

In Poland, over twenty prehistoric flint exploitation sites are known, though less contain shafts, and even less with any observed advanced extraction features.

The Magonie-Folwarczysko syncline was the only source of striped flint exploited in prehistoric times. This single deposit, headed by the largest and principal component part of Krzemionki Opatowskie Mining Field at its northwest end, stretches in an ESE–WNW orientation for 15 km and includes the mining region’s two other most significant and best-preserved mining fields of Borownia and Korycizna. The three mining fields, together, have been selected to represent the entire mining region that was thoroughly investigated as part of the comparative analysis. Other striped flint mines examined were Łysowody (not preserved), Księża Rola Mała (not preserved), Księża Rola Duża (minor preservation), Ostroga (minor preservation), Nowa (minor preservation), Skałecznica Duża (minor preservation) and Skałecznica Mała (not preserved).

All sites were investigated using a combination of sources including LIDAR, aerial photography, and recent field visits, the literature, and records of archaeological surface examination in the field from 1920 to 2017 (excavation for carbon dating only at Borownia in 2017, and planned for Krzemionki and Korycizna in 2018). All sites – except Krzemionki, Borownia and Korycizna – were excluded mostly for reasons of their small size and heavily degraded/almost non-existent surface remains caused through various land-use pressures such as former limestone quarrying, agricultural ploughing/bulldozing, and intensive forestry extraction.

The analysis of the contemporary settlements in the region surrounding the prehistoric mines of striped flint on the lower Kamienna River brings the following conclusions:

• There is a visible difference in the number of sites present on the Sandomierska Upland and Iłżeckie Foothills (Przedgórze Iłżeckie), which was obviously caused by different conditions for settlement between the two areas.
• There is a quality difference between the sites located in each area. Notably, the big earthen structures which are present in the Upland do not exist in the Foothills area.
• The sites differ in terms of their primary purpose as well – while those at the Sandomierska Upland had mainly housing and sepulchral function, those located at the Iłżeckie Foothills are connected to flint exploitation.
• It appears a key role has been played by the Kamienna River, which became a ‘settlement corridor’ providing a connection between the densely settled Sandomierska Upland and the mining area of Iłżeckie Foothills.
• It is interesting to draw a comparison between the locations of KPL (Funnel Beaker
Culture) and KM (Mierzanowicka Culture) settlements. They both seem to be equally dynamic, the concentration of settlements is similar however the location of the two varies (KPL is located higher and KM lower).

Overview of the most important Neolithic and early Bronze Age flint mines in Poland

Krzemionki

Located 8 km north-east of Ostrowiec Świętokrzyski, this is the largest and most well-known (international reputation) mining field in the region discovered July 19, 1922. The deposit of striped flint, parabolic in shape, occupies and area of 78.5 ha, and is 4.5 km long by between 20 m and 150 m wide. Pits, shafts, waste heaps, chipping floors and temporary camps survive at surface in a wooded reserve, whilst underground there are extensive and unparalleled accessible prehistoric flint mine workings.

The site was selected as a component part because: of its international reputation as one of the world’s largest and most important Neolithic flint mines, as one of the two principal areas of striped flint mines discovered in 1921 and of three originally identified for protection in the 1930s; it represents the largest source of striped flint in prehistory, accounting for an estimated over 90% of output, and corresponds to processing in Gawroniec Settlement and the distribution network represented by striped flint finds; its close relationship in location to other component part mining fields on the extension of its parabolic deposit; its large size (compared globally); its high integrity, authenticity and excellent state of preservation.

Borownia

Located 5.5 km northeast of Ćmielów, and 7 km southeast of Krzemionki Opatowskie. The part of the flint outcrop exploited in prehistory is 700 m long by (typically) 40 m wide, with an area of 2.7 ha. Pits and shafts are well preserved as surface earthworks situated in woodland and scrub, divided by a 125 m-long section of farmland and a road (which abuts the eastern segment of the mining field) where any surface earthworks, if they existed, are levelled.

The site was selected as a component part because, as one of the two principal areas discovered in 1921 and of three originally identified for protection in the 1930s, it complements Krzemionki Opatowskie Mining Field: a rare source of striped flint in prehistory (corresponding to processing in Gawroniec Settlement and the distribution network represented by striped flint finds); its close relationship in location on the extension of the southern limb of the parabolic deposit of Krzemionki; its comparatively large size (compared with excluded mines in the syncline); its high integrity and excellent state of preservation, pristine authenticity and relative lack of investigation. Regarding the latter, surface investigations have long confirmed its prehistoric flint mining function, recent geophysical studies (and surface spatial mapping) interpret underground structures to be similar to Krzemionki (pillar-chamber mines relatively deep in competent
limestone) and excavation for carbon dating purposes (in 2017) indicates late Neolithic – middle Bronze Age activity.

Korycizna

Located 2 km ESE of Borownia, a striped-flint outcrop exploited in prehistory over a length of 625 m by (typically) 30 m wide, with an area of 1.7 ha. Pits and shafts are located in remote forest.

The site was selected as a component part because, discovered in 1931 as the third of the three principal areas originally identified for protection in the 1930s, it complements Krzemionki Opatowskie Mining Field: a rare source of striped flint in prehistory (corresponding to processing in Gawroniec Settlement and the distribution network represented by striped flint finds); its close relationship in location as the furthest extension of the southern limb of the parabolic deposit of Krzemionki; its comparatively large size (compared with excluded mines in the syncline); its high authenticity, integrity and state of preservation in terms of surface industrial landscape, and relative lack of investigation. Regarding the latter, surface investigations have long confirmed its prehistoric flint mining function, recent geophysical studies (and surface spatial mapping) interpret underground structures to be shallower than Krzemionki (probably niche-gallery in fractured limestone). Excavation for carbon dating purposes is planned for 2018.

The vast chamber mines of Krzemionki represent the prehistoric world’s most impressive achievement of the time.

Professor Romuald Schild
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Foreign Associate, National Academy of Sciences, Washington, USA
Honorary Fellow, Society of Antiquaries of London, UK
Table of prehistoric flint mines in the Magonie-Folwarzysko syncline and its immediate vicinity examined for the selection of component parts during the nomination process

<table>
<thead>
<tr>
<th>No.</th>
<th>Village/Town/ City</th>
<th>District (powiat)/ commune (gmina)</th>
<th>Name of mining field</th>
<th>Ownership</th>
<th>Entry into register of monuments (year)</th>
<th>Approximate surface area/ length: width</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Łysowody/ostrowiecki/Ćmielów</td>
<td>Krunio</td>
<td>State Treasury</td>
<td>–</td>
<td>0.3 ha length: 210 m width: 10–20 m</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Ruda Kościelna/ostrowiecki/Ćmielów</td>
<td>Księża Rola Mała</td>
<td>State Treasury; private property</td>
<td>1981</td>
<td>0.32 ha length: 80 m width: 45 m</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Ruda Kościelna/ostrowiecki/Ćmielów</td>
<td>Księża Rola Duża</td>
<td>State Treasury</td>
<td>1981</td>
<td>2.5 ha length: 250 m width: 100 m</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Ruda Kościelna/ostrowiecki/Ćmielów</td>
<td>Ostroga</td>
<td>State Treasury</td>
<td>1982</td>
<td>0.25 ha length: 65 m width: 40 m</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Ruda Kościelna/ostrowiecki/Ćmielów</td>
<td>Borównia</td>
<td>State Treasury; private property</td>
<td>1935*/1981</td>
<td>2.1 ha length: 700 m width: 30–50 m</td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>Łysowody/ostrowiecki/Ćmielów</td>
<td>Nowa</td>
<td>State Treasury</td>
<td>–</td>
<td>0.5 ha</td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>Sudół, Stoki Stare, Ruda Kościelna/ostrowiecki/Bodzechów and Ćmielów</td>
<td>Krzemionki</td>
<td>State Treasury; private property</td>
<td>1928*/1999**</td>
<td>78.5 ha length: 4.5 km, width: 20–150 m</td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>Teofilów/opatowski/Tarłów</td>
<td>Skałecznica Duża</td>
<td>State Treasury; private property</td>
<td>–</td>
<td>0.8 ha length: 185 m width: 40–50m</td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td>Teofilów/opatowski/Tarłów</td>
<td>Skałecznica Mała</td>
<td>private property</td>
<td>–</td>
<td>0.1 ha length: 30 m</td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td>Wojciechówka/opatowski/Ożarów</td>
<td>Koryczna</td>
<td>State Treasury; private property</td>
<td>1934*/1982</td>
<td>1.6 ha length: 625 m width: 10–40 m</td>
<td></td>
</tr>
</tbody>
</table>

* Date of establishment of the archaeological reserve  
** Date of the last renewal of the entry into the register of monuments
3. Justification for Inscription

Figure 171. Location of prehistoric flint mines in the Magonie-Folwarczysko syncline and its immediate vicinity examined for the selection of component parts during the nomination process, a – prehistoric striped flint mines, b – main settlements, c – other prehistoric flint mines (chocolate flint) (authors: U. Jedynak and A. Jedynak).
The focus of the nomination is Neolithic shaft mines in striped-flint, in particular the main deposit in the Magonie-Folwarczysko syncline, although some of the other key Neolithic and Bronze Age flint mines for other flint types (for example the so-called ‘Jurassic Krakow flint’ and ‘chocolate flint’) were evaluated as part of the national comparative analysis. Although not regarded as close comparators, most barely being regarded as underground mines, the following selected Neolithic and Bronze Age flint mines in Poland were evaluated:

Tomaszów

Located on the northwest slope of Rzeczkw Hill along the upper Jurassic ridge that slopes to the northeast towards the Radom Plain, in the western cluster of ‘chocolate’ flint mines (its easternmost mine). Discovered in 1968 during a systematic survey of chocolate flint mines exploitation points, and excavated in the 1970s. There is evidence of Neolithic flint mining (pits and shallow shafts, 3 to 4 m deep) that dates from around 4,000 BCE to the Early Bronze Age (2,000 BCE). There are likely several hundred pits and shafts in number, and some excavated shafts have small niche workings at the bottom. Many workshops and camps on sand dunes in the neighbourhood of the mine.

Flint type (chocolate); flint beds hosted in karstic clays and limestone weathering product (as opposed to hard limestone); shallow shafts with small niches (rarely); on-the-spot production of blades, distribution is quite well known as it is possible to recognise (up to 180 kilometres to the north); no mining morphology preserved due to heavy ploughing.

Wierzbica ‘Zele’

Located in a belt of chocolate flint mines in weathered Upper Jurassic limestone and marl of the northeast fringe of the Holy Cross Mountains, in the Ilza Foreland, near the border with the Radom Plain, approximately 20 km south of Radom. The black-brown chocolate flint mine was worked in the early and later Bronze Age (possibly late-Neolithic, too) and covers an area of 400 x 300 m and was discovered in the late 1920s/30s, and shafts excavated in 1980–88 attained a maximum depth of 7 m. Antler picks were used and hard hammers from erratic stones. Numerous levelled chipping floors in secondary position. In Early Bronze Age (and maybe Late Neolithic) products of axehead roughouts and possible sickles. In late Bronze Age (approximately 1,000 BCE) characteristic large backed blades (‘Zele’ type) and flakes. There is no mining morphology preserved due to ploughing.

Polany II

Located in the Ilza Foreland, near the village of Polany, several kilometres south-east of Wierzbica ‘Zele’ flint mine. This chocolate flint mine in karstic clay and limestone rubble with flint nodules underlain by platey weathered limestone, and camp-workshop site, was excavated in 1971–72...
and in 1988. Flint exploitation pits and closely packed shallow shafts (2–2.5m deep) were found, but now there is no mining morphology preserved due to ploughing. The date of mining is Early Bronze Age (and possibly late-Neolithic), Mierzanowice culture and probably Corded Ware culture and Globular Amphora culture (as the site yielded a polished striped-flint axe from Krzemionki).
No traces of settlement.

**Polany Kolonie**

On the border of the village is located this chocolate flint mine in limestone rubble with flint platy nodules. Open pits and shafts less than 2 m deep. Early Bronze Age due to c 14 dates and morphology of artefacts. Excavations were made in 1971–72. Possible Globular Amphora Culture site due to axe found in field in neighbourhood of the site.

**Ożarów**

Early Bronze Age flint mining shallow open shafts only (not underground). Produced flint sickle and bifacial axe-head rough-outs. Special type of Ożarów flint was excavated that was characteristic for the site.

**Świeciechów**

The prehistoric mine in Świeciechów is located on the right bank of the Vistula valley (Lesser Poland) and is characterised by Turonian (so-called Świeciechowski) flint. This distinctive variety of grey with white spots is well-represented in the archaeological excavations at Gawroniec Settlement in the nominated Property. The flint deposit is shallow and contains large (up to 50 cm long) fragments of plate concretions which lie at a depth of over 60 cm in a thick layer of limestone debris. Extraction was by oval pits and ditches up to 85 cm deep (originally deeper) and 80–120 cm wide. Flint artefacts obtained in the mine can be placed chronologically from the late Palaeolithic to the early Bronze Age. The most numerous are the preformed tools and unfinished tetrahedral axes as well as residues of production of fine macrolithic chips related to the Neolithic Funnel Beaker culture. The first surface tests were made by Z. Krzak in 1963, and excavations were conducted by B. Balcer in 1967 and 1970. The mining area occupies a space of approx. 1200 x 900 m and is most concentrated on the edge of the plateau and on the slopes of the valley which extends in a belt 1 km long and 300 – 500 m wide along the S-N axis.
Overview of the most important archaeological sites from the early and late Neolithic and the early Bronze Age

Gawroniec Hill, Ćmielów

Gawroniec Settlement in Ćmielów may be considered one of the most important prehistoric settlement sites in Poland. Located in the northern border of Sandomierska Upland, approximately 30 m above the bottom of the Kamienna River valley, this 8-hectares area provided ideal conditions for defence. From the north, it is bordered by the steep side of the river valley whereas its southern and eastern ends are protected by the 15 m deep loess canyon with steep sides. A similar canyon cuts the settlement from the West. The highest point in the settlement is situated at an altitude of 204 m above sea level.

The discovery of the site was made in the 1920s by a teacher from Ostrowiec Świętokrzyski, Zdzisław Lenartowicz. Due to studies of prehistoric mining activity in Krzemionki area, it was also investigated many times by Stefan Kurowski. Excavation works were conducted by Zofia Podkowińska between 1947–1961. 4500 m² were researched at the time and, as a result, thousands of ceramic, stone, flint and fauna fragments were recovered.

Most of the material and all of the structures which were uncovered at the site are the remains of the Funnel Beaker Culture settlement. The studies have shown that signs of human activity on the hill are concentrated in several areas of various character, from settlement to production (flint manufacturing, pottery, copper metallurgy). The signs of residential buildings above the ground were found only in one place, however, there were many pits with fire and stoves. Additionally, a large amount of waste produced as a result of the processing of striped and świeciechowski flint proves the pivotal role the inhabitants of the settlement played both in production and distribution of these resources. The production included massive axe blades as well as long flint blades used for manufacturing knives and sickles. Pottery was also very common and utensils produced here were very diverse. Apart from large storage vessels, funnel-shaped beakers and vases with ears in the shape of a ram head and with 'ansa lunata' handles and collared flask were also produced here. The archaeologists also found ceramic pipes and a large amount of ceramic weaving spindles. The principal activity of the inhabitants of the Gawroniec settlement, however, was agriculture and husbandry, which is indicated by the pit-granaries containing grain remains as well as various waste-pits where bones of cows, pigs, goats and sheep were found. Despite its size and importance, the Gawroniec settlement did not exist for a long time. Radioactive dating techniques helped to estimate that the settlement existed for approximately 250 years, between 3500 and 3200 BCE.

Krzczonowice

Krzczonowice is located in the northern part of the Sandomierska Upland, on the loess hill which dominates the valley of the right tributary of the Kamienna River – the Krzczonowianka/Obręczówka River. The site has been well known for many years, mainly due to the accidental discovery of a tomb containing cinerary urns, Bronze jewellery, flint and ceramic findings as well as silver Roman denarius. The first archaeological surface survey, conducted by Krzysztof
Kowalski, took place in 1970s and it was repeated in 1997 by the group of researchers: Ms Barbara Bargiel, Marek Florek, Jerzy Libera and Anna Zakościelna. Archaeological material from various epochs was found on the area of 3 hectares, both on the highest parts of the hill and on the slopes. Archaeological excavation works were conducted under the supervision of Artur Jedynak and Kamil Kaptur between 2006 and 2011. The decision to conduct the study was taken due to erosion of the site’s surface caused by deep ploughing leading to fast destruction of the archaeological sites. The survey was conducted mainly in the highest parts of the hill where there are many concentrations of historic material including *inter alia* human bones and stones. Altogether, during five research seasons the archaeologists surveyed the area of 700 m². Between 2010–2011 the team of researchers (Marcin Jaworski, Marcin M. Przybyła, Piotr Szczepanik and Piotr Wroniecki) conducted geophysical prospection on the area of 3.5 hectares.

Out of 45 archaeological sites discovered during the survey, 20 turned out to represent Globular Amphora Culture. These sites had various forms and purposes: from residential through utility and workshop. The excavated historic material included mainly ceramics (approx. 1500 pieces) and animal remains (also approx. 1500 pieces) as well as clay pugging, flint and stone tools. These represent remains of various forms of activities of the Globular Amphora Culture settlement inhabitants. Worth noticing are well-documented malacological materials found in the settlement that enabled a reconstruction of the surrounding landscape and provided data about the climate of the Sandomierska Upland in the half of the third century BCE.

The geophysical works and an additional surface survey conducted simultaneously with excavations enabled to estimate both the size of the KAK (Globular Amphora Culture) settlement (1.5 hectares) and its more precise localisation in the highest parts of the hill, on which the site no. 63 is located. According to the results of thermoluminescence dating, the ceramics was created between approx. 4600–4300 BCE, which indicates this settlement comes from the late phase of Globular Amphora Culture.

**Mierzanowice**

Mierzanowice is located on the distinct, long loess hill of longitudinal arrangement, cut from the upland on both sides by the valley of the Przepaść River and its nameless left tributary. In the north, it merges with the higher parts of the Sandomierska Upland. The surface of the site lies approx. 20 m above the bottom of the Przepaść valley, 195–197 m above sea level. The site covers an area of approximately 1 hectare.

The site was discovered by chance in 1935 during agricultural works. Excavations were conducted by Kazimierz Salewicz in 1938 and they covered the area of 10 000 m². 240 archaeological sites were uncovered and surveyed including, *inter alia*, storage hollows and tombs belonging to almost all cultures of the decline of the Early Neolithic and the beginning of the Bronze Age at the Sandomierska Upland, including the Funnel Beaker Culture, Globular Amphora Culture, Złota Culture, Corded Ware Culture and most of the Mierzanowice Culture. The discoveries at the no.1 site in Mierzanowice turned out to be fundamental for creating an account of prehistoric times of South-East Poland at the turn of third and second Century BCE and the name of the town itself gave the name to the entire archaeological culture present during that time in the area of the Upper Vistula River basin, Moravia, Slovakia and western Ukraine. The research conducted in Mierzanowice helped to restore the burial rites of the peoples of Mierzanowicka...
Culture in the Sandomierska Upland, including, *inter alia*, time and cultural variations; the size of human population and its health condition; as well as material and spiritual culture of the peoples inhabiting the region at that time. Together with neighbouring sites no. 4 in Mierzanowice and no. 52 in Wojnowice, which are located at the land of the same form and of similar chronology, the site no. 1 in Mierzanowice creates a cluster of the size of several hectares.

**Lemierze**

This settlement from the Neolithic and the Bronze Age (exemplified by the findings associated with Funnel Beaker Culture, Globular Amphora Culture, Łużycka, Trzciniecka and Mierzanowicka Cultures) was discovered by Stefan Krukowski on the terrace above flood plain on the right bank of the Kamienna river. The site is an area of 10 hectares with dimensions of 600 x 200 m. The excavation was studied in 1973 by Krzysztof Kowalski. Three pits of the total size of 221 m² were dug. The relics discovered indicate that the site was mainly used as a workshop space (manufacturing of axes made of striped flint). In addition, ceramic fragments representing mainly Trzciniecka and Globular Amphora Cultures were also excavated.

**Rudka Bałtowska**

This is a multicultural settlement and a camp that date to the period of time stretching from Palaeolithic to the Roman influence period. It is located on the left bank of the Kamienna river on the terrain above flood plain. According to its discoverer and researcher it covers an area of approx. 250 x 70 m. During one, and so far, the only archaeological excavation time in 1974, two archaeological pits of 17 m² and 6 m² were established. The pit no. I was located in the central part of the site while the pit no. II on the border between the slope and the bottom of the Kamienna river valley. The majority of excavated relics were found in the humus and they included hundreds of ceramic fragments and several thousands of stone pieces. These were mainly semi-finished double-sided axes, waste from the manufacturing of axes as well as tools made of chocolate and świeciechowski flint.

**Ruda Kościelna**

The settlement represents Funnel Beaker and Mierzanowska Cultures and it is situated north of the site no. 18 – the ‘Borownia Mining Field’. It was discovered by Stefan Krukowski before World War II and, in 1981, it was verified by Janusz Budziszewski. During the AZP study (studies of the Archaeological Picture of Poland) conducted by Jerzy Libera in 1990 a fragment of ceramics and flint flakes were found. The collection gathered by S. Krukowski includes approximately 270 pieces of ceramics, two wearing spindles, approximately 160 fragments of flint used for the manufacturing of axes as well as semi-finished four-sided axes and one semi-finished double-sided axe. The site has not been excavated so far.
3. Justification for inscription
3.3 Proposed Statement of Outstanding Universal Value

Brief Synthesis

*Krzemionki prehistoric striped flint mining region* (in short: Krzemionki) is located in the north-eastern fringe of the Świętokrzyskie (Holy Cross) Mountains in central Poland on both sides of Kamienna River. It is a serial property comprised of four component parts: the principal Krzemionki Opatowskie Mining Field; two smaller mining fields, Borownia and Korycizna, aligned on the same geological structure; and the Gawroniec prehistoric miners’ permanent settlement that received rough axes from the mines for finishing and polishing prior to distribution. The property dates from 3,900 BCE to 1,600 BCE (Neolithic to Early Bronze Age) and is one of the largest known complexes of its type. It is also the most complete and wholly readable socio-technical system of prehistoric underground flint mining and processing known in the world, and illustrates the greatest range of prehistoric flint mining techniques known in a single property. Features include great chambers with a floor area of over 500 m² that are unknown from any other site. Moreover, a unique type of flint – striped flint banded in exceptional zebra-like patterns of alternating shades of grey – was mined and fashioned into axes and distributed in a verifiable radius of 650 km from the complex, in present-day Germany, Czech Republic, Moravia, Slovakia, western Ukraine, Belarus and Lithuania.

A diverse range of mine types are also identified with different surface expressions in a remarkably intact anthropogenic surface that presents a rare prehistoric industrial landscape of shaft depressions and up-cast waste, remnants of flint workshops, miners’ camps and communication routes. Gawroniec Settlement, integral to the functional integrity of the deposit management system, is clear testimony to the organisation of a prehistoric community based around mining.

**Criterion (i):** *Krzemionki prehistoric striped flint mining region* is an outstanding example of exceptional creative and technical ability, providing clear testimony to early human inventiveness, mining techniques and organisation. The network of mine shafts, galleries and chambers excavated in hard limestone illustrates the greatest range of prehistoric mining techniques evidenced in a single site. It is an exemplar of the prehistoric ‘mining phenomenon’ whereby a radically new principle of underground mining allowed large quantities of better quality flint to be exploited from deeply buried seams.

**Criterion (iii):** *Krzemionki prehistoric striped flint mining region* is illustrative of the living and working patterns of settled prehistoric communities that distinguish the Neolithic period from that which preceded it. It provides exceptional scientific and anthropological evidence that supports a complete physical testimony of a distinctive cultural tradition that has disappeared. The value of the nominated Property, including the integral Gawroniec
Settlement (also the region’s most significant prehistoric settlement), is further enhanced by the proven distribution of striped-flint axes that have been identified in a radius of over 650 kilometres from the complex – the greatest recorded range for prehistoric flint axes as significant indicators of prehistoric movement.

**Criterion (iv):** *Krzemionki prehistoric striped flint mining region* provides exceptional evidence that the prehistoric period, which brought flint mining to produce tools, was a watershed period in the history of humankind. Diverse underground prehistoric mining structures are present in the nominated Property – comprising open-pit, niche-gallery, gallery, room-and-pillar, and chamber mines – and primary workshops survive intact amongst well over 4,000 shafts and pits.

**Integrity**

*Krzemionki prehistoric striped flint mining region*, as a whole, comprises the best preserved, most technically diverse and complete prehistoric flint mining assemblage known. All elements necessary to express potential Outstanding Universal Value are included in the serial property that represents the exploitation of the only deposit of striped flint to be mined in prehistory. Principle features and attributes have been confirmed in detail using a combination of historic and recent archaeological research, including Airborne Laser Scanning that has accurately mapped the sites in 3D under forest cover. The permanent settlement site, on a promontory in open agricultural fields, was archaeologically excavated in the late-1940s and ‘50s and the boundary exceeds the archaeological site boundary that contains all known evidence of prehistoric settlement.

The site does not suffer from current adverse development or neglect.

**Authenticity**

*Krzemionki prehistoric striped flint mining region* is characterised by an exceptional level of authenticity, in all its attributes, expressed in elements that include: the well preserved form and structure of the underground such as shafts, chambers, communication galleries, transport corridors, supporting pillars or waste heaps of mining and processing, as well as the aboveground industrial landscape consisting of shaft depressions and up-cast waste, remnants of flint workshops, miners’ camps and communication routes. The majority of the mining fields are left unexcavated. At Krzemionki Opatowskie Mining Field, a small segment of the mining field has been excavated archaeologically and, after some conservation work, gives unparalleled access to workings with a diversity and combination of attributes that have remained almost unchanged for over 5,000 years. Attributes of Gawroniec Settlement are equally easily read in terms of location and setting, form, and archaeological evidence that
is tangible proof of organisation and process directly tied to the mining fields. Archaeological excavations were conducted between 1947 and 1961 and apart from extensive waste from flint processing, dateable evidence included pottery (large storage vessels, funnel-shaped flasks and vases, ceramic pipes, and ceramic weaving spindles) and organic remains which were radiocarbon-dated to between 3,500 and 3,200 BCE. New, additional and higher resolution, radiocarbon dates for the mining fields are being compiled during 2017–2018.

**Protection and Management**

The nominated Property is under full legal protection in its entirety. The management system for *Krzemionki prehistoric striped flint mining region* will be implemented by the ‘Krzemionki’ Archaeological Museum and Reserve (Muzeum Archeologiczne i Rezerwat 'Krzemionki'), a local museum that is renowned in Poland and which takes a lead role in the management and protection of Krzemionki. Its organisational structure will be adapted and extended to the other three component parts in the series as part of a new property management plan process currently (2018) in development and which will be adopted in that year. Currently there are no recognisable threats or vulnerabilities to the preservation of the nominated Property for future generations.

On the importance of the *Prehistoric Striped Flint Mining of Krzemionki Region*, I feel bound to quote the words of my late mentor and the author of the first book on Krzemionki, Stefan Krukowski, 1933: *Krzemionki is one of the few great memorials to the early childhood of modern civilization. Its importance reaches far beyond the borders of Poland.*

*Professor Romuald Schild*

Former Director of the Institute of Archaeology and Ethnology, Polish Academy of Sciences
Foreign Associate, National Academy of Sciences, Washington, USA
Honorary Fellow, Society of Antiquaries of London, UK
3. Justification for Inscription
4. State of Conservation and Factors Affecting the Property
4.a Present State of Conservation

Current Physical Condition of the Property


Within the boundaries of each component part there are various elements that reflect the values of the prehistoric exploitation of striped flint in the Krzemionki region. Component parts numbers 1 to 3 are prehistoric cultural mining landscapes with above and below ground remains that share distinct similarities, including their setting of forest. Component part number 4 is a surface archaeological site, with no primary mining features (but does contain secondary flint processing features), in a very different setting of open agricultural land.

Overall, the Property in its entirety – considering its typology and chronology, its location and comparable properties – its present state of conservation is exceptional. This can be seen to be due to various factors, including: geology and soil; type and intensity of workings below and above ground; lack of land-use pressure; and longstanding forest cover.

Component part number 1 is by far the most extensive, complex and investigated, and a list of elements representing key attributes has been tabulated; there also remains massive archaeological potential, but likely in categories that have already been determined. Component parts numbers 2 and 3 are relatively pristine prehistoric mining landscapes that have received limited investigation at surface, and no excavation and investigation underground. They have massive archaeological potential. Component part number 4 has been partially excavated, but there remains significant archaeological potential.

The Neolithic flint mines ‘Krzemionki’ stand out clearly from other properties of a similar kind due to their size, cognitive qualities as well as to the scope and character of the archaeological research carried out and innovative conservational solutions applied.

Adam Jarubas
Świętokrzyskie Province Marshall
Particular elements are connected with different functions which influenced their location, form, spatial relationship, degree of usage, state of conservation etc:

1 **Krzemionki Opatowskie Mining Field**

<table>
<thead>
<tr>
<th>Element and code number</th>
<th>Physical condition</th>
<th>Photography</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1 Prehistoric underground</td>
<td>This prehistoric underground workings at Krzemionki have received the greatest amount, and sustained, conservation and access works (particularly since the late 1950s), and corresponding maintenance, of any part of the nominated Property. Physical condition – very good.</td>
<td><img src="image1.jpg" alt="Image" /></td>
</tr>
<tr>
<td>1.1.1 Prehistoric underground ‘chamber mines’</td>
<td>The chamber mines are the deepest, but also some of the most structurally competent, prehistoric underground workings at Krzemionki. Those on the visitor access level have received the greatest attention in terms of conservation and, by necessity of law, safety and access works, such as: roof support (methods vary from the 1950s to the early 2000s); door frames and steel pillars; rock consolidation via grouting, pressure vertical injection, layer bonding and sealing. They also, necessarily, are subject to the highest level of maintenance in that visitors are conducted daily to see them. Physical condition – very good.</td>
<td><img src="image2.jpg" alt="Image" /></td>
</tr>
<tr>
<td>1.1.2 Prehistoric underground ‘pillar-chamber mines’</td>
<td>The pillar-chamber mines are also, predominantly, structurally competent, though again those on the visitor access level (route number 1) have received the greatest attention in terms of conservation and, by necessity of law, safety and access works, such as: roof support – methods vary from the 1950s to the early 2000s, from mortared masonry walls and arches to modern steel beam props and sets; rock consolidation via anchor plates, grouting, pressure vertical injection, layer bonding and sealing. They too, are necessarily subject to the highest level of maintenance in that visitors are conducted daily to see them. Physical condition – good.</td>
<td><img src="image3.jpg" alt="Image" /></td>
</tr>
<tr>
<td>Element and code number</td>
<td>Physical condition</td>
<td>Photography</td>
</tr>
<tr>
<td>-------------------------</td>
<td>--------------------</td>
<td>-------------</td>
</tr>
<tr>
<td>1.1.3 Prehistoric underground shafts</td>
<td>Prehistoric shafts were excavated for research purposes and modified for researcher and visitor access. Shafts (1,2,3) in visitor route number 1 were researched during archaeological excavations before World War II and were subsequently secured for access by placing concrete domes over the shafts. Shaft 1 was a former visitor entrance but is now used for emergency access. Physical condition – good.</td>
<td>![ Shaft image ]</td>
</tr>
<tr>
<td>1.1.4 Prehistoric underground communication galleries</td>
<td>Injection in communication galleries of mines 795 and 804. Physical condition – very good.</td>
<td>![ Communication gallery image ]</td>
</tr>
<tr>
<td>1.1.5 Prehistoric underground waste management features</td>
<td>Explored during archeological and mining works; protected by means of protective nets/wire meshes. Physical condition – very good.</td>
<td>![ Waste management image ]</td>
</tr>
<tr>
<td>1.1.6 Prehistoric underground lighting features</td>
<td>Not conserved. Physical condition – very good.</td>
<td>![ Lighting feature image ]</td>
</tr>
<tr>
<td>1.1.7 Prehistoric underground evidence of fires</td>
<td>Explored during mining works preparing underground tourist route. Physical condition – good.</td>
<td>![ Evidence of fires image ]</td>
</tr>
<tr>
<td>Element and code number</td>
<td>Physical condition</td>
<td>Photography</td>
</tr>
<tr>
<td>-------------------------</td>
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<td>-------------</td>
</tr>
<tr>
<td>1.1.8 Prehistoric underground graffiti</td>
<td>Tourist route no.1: image of the Goddess was conserved. Physical condition – very good.</td>
<td><img src="image1.png" alt="Image" /></td>
</tr>
<tr>
<td>1.1.9 Underground ‘niche-gallery mines’</td>
<td>The area known as ‘Great Chambers’ was conserved; requires more care/conservation procedures/preservation works.</td>
<td><img src="image2.png" alt="Image" /></td>
</tr>
<tr>
<td>1.2 Prehistoric ‘industrial landscape’</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.2.1 Chamber mine shafts and tips</td>
<td>No conservation procedures were conducted. Physical condition – very good.</td>
<td><img src="image3.png" alt="Image" /></td>
</tr>
<tr>
<td>1.2.2 Pillar-chamber mine shafts and tips</td>
<td>In a region of mines 1, 2, 3 serious damages and transformation (Kleiman’s quarries). As a whole, very good.</td>
<td><img src="image4.png" alt="Image" /></td>
</tr>
<tr>
<td>1.2.3 Niche-gallery shafts, opencast pits and tips</td>
<td>Physical condition – good.</td>
<td></td>
</tr>
</tbody>
</table>
4. State of Conservation and Factors Affecting the Property

<table>
<thead>
<tr>
<th>Element and code number</th>
<th>Physical condition</th>
<th>Photography</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.2.4 Chipping floors/workshops</td>
<td>Traces of looters’ flint robbery. Most maintained in unaltered condition. On the whole, very good.</td>
<td><img src="image1.jpg" alt="Image of chipping floors/workshops" /></td>
</tr>
<tr>
<td>1.2.5 Temporary camps</td>
<td>Traces of campsites discovered in the region of mine 7 and sinkholes (Kał Cebuli). Archaeologically studied. Those that remain, good (some were lost to quarrying in the 1950s–70s).</td>
<td><img src="image2.jpg" alt="Image of temporary camps" /></td>
</tr>
</tbody>
</table>

2 Borownia Mining Field

This site had never been excavated until 2017, when a cross-trench was excavated in order to retrieve charcoal samples for radiocarbon dating. The north-south arm of the trench traversed a shaft hollow and shaft tip, and not only was good charcoal retrieved for dating analysis, but so too a prehistoric worked flint artefact that is initially thought to indicate the Bronze Age.

![Figure 172](image3.jpg)

Figure 172. Hand-sized backed fake knife of ‘Zele’ type, found 6 July 2017 at ‘Borownia’ cutting ‘south’ (author J. Lech).
### 4. State of Conservation and Factors Affecting the Property

<table>
<thead>
<tr>
<th>Element and code number</th>
<th>Physical condition</th>
<th>Photography</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1 Prehistoric underground</td>
<td>Not accessible.</td>
<td>Not accessible.</td>
</tr>
<tr>
<td>2.2 Surface ‘industrial landscape’</td>
<td>Physical condition – very good.</td>
<td><img src="image1.jpg" alt="Image" /></td>
</tr>
<tr>
<td>2.2.1 Mine shafts and tips</td>
<td>The prehistoric anthropogenic landscape (shaft hollows and dump mounds) is relatively pristine in both wooded segments of the mining field. Tree growth is always young as local people harvest firewood by hand.</td>
<td><img src="image2.jpg" alt="Image" /> Between the two wooded segments of the mining field is a road and an arable field, both of which are superimposed on a levelled middle segment of the mining field.</td>
</tr>
<tr>
<td>2.2.2 Processing chipping floors/workshops</td>
<td>This was thought to be relatively pristine, and was proven to be so in 2017 with a very shallow excavation to remove the humus layer. This revealed a concentration of collected ‘hammerstones’ (hard glacial erratic stones of Scandinavian origin that are found locally widely distributed), lying with chipped flint material and shaft dump material.</td>
<td><img src="image3.jpg" alt="Image" /></td>
</tr>
<tr>
<td>2.2.3 Settlement features</td>
<td>The suspected site, adjacent to the mining field and above the river cliff, is presently un-excavated. Strong indications of its position are revealed by a concentration of prehistoric pottery scatter and prolific workshop residue of striped flint. Condition – buried archaeology.</td>
<td><img src="image4.jpg" alt="Image" /></td>
</tr>
</tbody>
</table>
3 Korycizna Mining Field

No archaeological excavations have taken place on the site (planned for 2018, for the purposes of obtaining charcoal samples for radiocarbon dating). Geophysical surveys have taken place.

<table>
<thead>
<tr>
<th>Element and code number</th>
<th>Physical condition</th>
<th>Photography</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1 Prehistoric underground</td>
<td>Not accessible.</td>
<td></td>
</tr>
<tr>
<td>3.2 Surface ‘industrial landscape’</td>
<td>Physical condition – very good.</td>
<td></td>
</tr>
<tr>
<td>3.2.1 Mine shafts and tips</td>
<td>The extensive linear mining field of shaft hollows and mine dumps survives in woodland but the surface shows signs of shallow digging for striped flint (ceased around 2011). Physical condition – very good.</td>
<td></td>
</tr>
<tr>
<td>3.2.2 Processing chipping floors/workshops</td>
<td>The areas of flint workshops appear more disturbed/degraded than either Borownia or Krzemionki. Physical condition – good.</td>
<td></td>
</tr>
</tbody>
</table>
4 Gawroniec Settlement, an archaeologically excavated production settlement

<table>
<thead>
<tr>
<th>Element and code number</th>
<th>Physical condition</th>
<th>Photography</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1 Processing chipping floors/workshops</td>
<td>The area of flint workshops is archaeological, situated in arable fields and was partially excavated in the 1940s and 1950s. The features remain buried and protected. They comprised pits from which loess was dug and used for protection on the timber built walls of huts, subsequently being filled with flint refuse from processing (flint in secondary position).</td>
<td><img src="image1.png" alt="Photography" /></td>
</tr>
<tr>
<td>4.2 Settlement features</td>
<td>The settlement site is archaeological, situated in arable fields and was partially excavated in the 1940s and 1950s. The features remain buried and protected.</td>
<td><img src="image2.png" alt="Photography" /></td>
</tr>
</tbody>
</table>

The type of element or feature, its function, materials and location, together with the subsequent use of the site and natural factors, combine to affect preservation and state of conservation.

When flint extraction ceased during the Early Bronze Age, the mining fields with their characteristic hummocky landscape of shaft hollows and primary and secondary waste heaps, became naturally re-forested with a succession of pine, sessile oak (*Quercus petraea*), and sporadic birch and aspen. Until the early twentieth century, the mining fields (three component parts) remained covered – and protected – by forest. Borownia remains mostly in forest (two main segments remain in forest, one segment is leveled at surface and comprises an arable field and is also crossed by a road), and Korycizna remains wholly in forest. Krzemionki suffered at least some clearance and ploughing in the 1910s and 1920s, and some limestone quarrying, causing some destruction to surface features and underground chamber mines, but the forest has since regrown.

At Krzemionki Opatowskie Mining Field archaeological excavations were made in the 1920s, 1930s, and again in the 1950s to the present day. In the early 1980s a short section of underground access tunnel was created. This was added to in 1990, and again in 2001 to 2004.

The underground areas are subject to natural processes connected with geology, air movement and water penetration, which, with proper management and monitoring, do not adversely affect the preservation of the nominated Property. There are common issues, such as periodic high levels of humidity (that requires enhanced ventilation), high spots of radon...
gas accumulation, and algal growth from warm lighting. Conservation and safety activities, which improve security and facilitate underground visitor access (such as chamber ceiling support), have principally been conducted within the main underground visitor route. Ceiling subsidence is monitored. In addition, shaft 4/606 has been excavated and modern safety and conservation infrastructure fitted in the shaft. In the chamber mine associated with shaft 4, limited (estimated 15 per cent of the total) archaeological excavations have been undertaken, comprising one communication gallery (of three), and the entire perimeter sidewall gallery.

State of Conservation

<table>
<thead>
<tr>
<th>Element</th>
<th>good</th>
<th>satisfactory</th>
<th>bad</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>Krzemionki Opatowskie Mining Field</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.1</td>
<td>Prehistoric underground</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.1.1</td>
<td>Prehistoric underground ‘chamber mines’</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.1.2</td>
<td>Prehistoric underground ‘pillar-chamber mines’</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.1.3</td>
<td>Prehistoric underground shafts</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Element</td>
<td>Good</td>
<td>Satisfactory</td>
</tr>
<tr>
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<td>--------------</td>
</tr>
<tr>
<td>2</td>
<td><strong>Borownia Mining Field</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.1</td>
<td>Prehistoric underground</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.2</td>
<td>Surface 'industrial landscape'</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mine shafts and tips</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Processing chipping floors/workshops</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Settlement features</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td><strong>Koryczna Mining Field</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.1</td>
<td>Prehistoric underground</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.2</td>
<td>Surface 'industrial landscape'</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mine shafts and tips</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Processing chipping floors/workshops</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td><strong>Gawroniec Settlement</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.1</td>
<td>Processing chipping floors/workshops</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.2</td>
<td>Settlement features</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Figure 173. Archaeological cutting at Krzemionki Opatowskie Mining Field in 2016 (author J. Lech).*
4. State of Conservation and Factors Affecting the Property

Figure 174. Borownia Mining Field, excavations 2017 (author J. Lech).

Figure 175. Krzemionki Opatowskie Mining Field, winter 2017 (author J. Lech).
Conservation Activities

Regular inspection, maintenance and small-scale conservation of the underground chambers is undertaken by the Museum staff (archaeologists) on an ongoing basis.

### Conservation activities, repairs and repair works realised to 2017

<table>
<thead>
<tr>
<th>Element</th>
<th>Conducted works and their scope</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Great Chambers</td>
<td>Protected by lining works/casing in chamber directly adjacent to tourist route, chambers 1, 2 and shaft 11/827.</td>
<td>1999–2001</td>
</tr>
<tr>
<td>Underground tourist access level</td>
<td>Creating/building new underground tourist access level. Secured by lining works/mining casing (props, sets).</td>
<td>2001–2004</td>
</tr>
<tr>
<td>Mine 821</td>
<td>Pressure vertical injection.</td>
<td>2005</td>
</tr>
<tr>
<td>Surface ‘industrial landscape’</td>
<td>Understorey clearance (Segment A).</td>
<td>2005</td>
</tr>
<tr>
<td>Mine 6/668</td>
<td>Archaeological works/excavations/was examined, secured, conservation procedures.</td>
<td>2005–2009</td>
</tr>
<tr>
<td>Underground tourist access level</td>
<td>Underground route secured by concrete belt (orange line).</td>
<td>2007</td>
</tr>
<tr>
<td>Surface ‘industrial landscape’</td>
<td>Viewing platform between pavilions over the surface of exploitation field.</td>
<td>2008</td>
</tr>
<tr>
<td>Underground tourist access level</td>
<td>Replacement/exchange of lighting.</td>
<td>2008</td>
</tr>
<tr>
<td>Mine 6/668</td>
<td>Secured.</td>
<td>2011</td>
</tr>
<tr>
<td>Underground tourist access level</td>
<td>Ventilation and evacuation shaft, tourist route, the Great Chambers secured by pressure vertical injection, lining works/mining casing (props, sets), protective wire meshes and mine workings protection covers.</td>
<td>2014</td>
</tr>
<tr>
<td>Surface ‘industrial landscape’</td>
<td>Understorey clearance (Segment A).</td>
<td>2016–2017</td>
</tr>
</tbody>
</table>
Planned principal conservation activities

<table>
<thead>
<tr>
<th>Element</th>
<th>Scope of works</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface ‘industrial landscape’</td>
<td>Understorey clearance (Segment A).</td>
<td>Every year in the autumn-winter period</td>
</tr>
</tbody>
</table>
| Tourist route          | Within the Project 'Increase of the availability of the Historical and Archaeological Museum in Ostrowiec Świętokrzyski by improving the infrastructure of the Archaeological Museum and Krzemionki Reserve and the Wielopolski Palace':  
  • Replacement of the power supply and the lighting in the underground tourist access level,  
  • Equalization/reduction/leveled of the bottom of the visitor gallery,  
  • Replacement of wire meshes securing waste management features and mine workings protection covers,  
  • Conversion/reconstruction of the pavilions,  
  • Conversion/reconstruction of shafts and installation of lifts for the handicapped,  
  • Replacement of viewing platform over Neolithic exploitation field between pavilions,  
  • Replacement of the House of Archaeologists,  
  • Demolition of old Museum buildings,  
  • Improving safety conditions (alarms, monitoring, fiber-optic cable, air-condition),  
  • Visual monitoring of exploitation field,  
  • Preparing new exhibition in pavilions.                                                                                                                                                                                                                                                                 | 2017–2019                                |

Investigation of the prehistoric underground workings has been taking place for archaeological research purposes, sporadically, for nearly ninety years; and of the surface prehistoric industrial landscape nearly the same, but less intensive. As modern investigative technology has developed, investigations have been undertaken and interpretation made as appropriate at the time. Safety issues include structural stability, although, as noted, the competent structural status of the monolithic well-bedded limestone – so beneficial to the Neolithic miners – counts equally well today. One issue that needs to be borne in mind, common to all Neolithic flint mines, and many other historic mines, is the routine backfilling of mined voids, for reasons of economical handling, and for reasons of additional structural stability. Great care needs to be taken when excavating this material.
4. State of Conservation and Factors Affecting the Property

4.b Factors Affecting the Property

The most important factors that have the potential to affect (negatively, or positively) the nominated Property include:

- Limestone quarrying, now ceased (and no longer permitted) within/adjacent to Krzemionki Opatowskie Mining Field and Korycizna Mining Field;
- Housing/residential development in two areas within the buffer zone of Krzemionki Opatowskie Mining Field (Magonie village to the north, and Sudół to the west) that has the potential to visually affect the setting;
- Potential investment within the buffer zone of Gawroniec Settlement;
- Illegal digging/robbing of striped flint from the prehistoric industrial landscape, particularly at Korycizna, and to a lesser extent at Borownia Mining Field and Krzemionki Mining Field. This activity, prevalent in the late 2000s, practically ceased around 2011 following interventions by the National Heritage Board of Poland at the Polish Police Headquarters, increased patrols of the police, Ostrowiec Świętokrzyski Forest District Guard Service and ‘Krzemionki’ Archaeological Museum and Reserve staff and security personnel – combined with the substantial production of striped flint of high ornamental/jewellery quality in newly active quarries elsewhere;
- Illegal tipping of waste/trash at Borownia Mining Field (next to the road) and at Korycizna Mining Field.

![Figure 176. Illegal tipping of household rubbish in the eastern wooded segment of Borownia Mining Field, next to the road (author B. Gamble).](image)

(i) Development pressures
(e.g. encroachment, adaptation, agriculture, mining)

**Quarrying**

All quarrying in the immediate vicinity of the nominated Property has ceased, and no future quarrying is allowed within the nominated Property. Further, no quarrying will be allowed within its buffer zone that may have a negative impact on World Heritage values. In 2014, the last active quarry (used in recent decades as a waste facility for its steelworks owner) was capped with topsoil (leaving a geological section in its face) and rehabilitated.
In 2016 planning permission to quarry north of the proposed buffer zone of Krzemionki Opatowskie Mining Field was declined on the basis of cultural heritage objections (citing Krzemionki Opatowskie and its position on the Polish Tentative List in the World Heritage nomination process).

![Figure 177](image1.png)

**Figure 177.** Rehabilitated quarry, and retained geological section, in the Krzemionki Opatowskie Nature Reserve, 2015 (author K. Kaptur).

![Figure 178](image2.png)

**Figure 178.** Planning permission sought to open a limestone quarry (3 hectares, up to 40 metres deep), 1 kilometre northwest of Krzemionki Opatowskie Reserve, was rejected in 2016. Key: red – quarry outline; blue – road; yellow – Reserve boundary; green – mining field; black – boundary of area Nature 2000 (author K. Kaptur).
Housing/residential development

Concerning Krzemionki Opatowskie Mining Field, no general development (houses etc.) is permissible within the nominated Property. In the settlement areas of Magonie and Sudół within the buffer zone, there are a number of plots with development potential in private hands. In Magonie, buildings within the existing village are located close to the boundary of the nominated Property. It is proposed that a ‘culture park’, that aims to protect associated values in the buffer zone and in the wider setting of the nominated Property, is also used as the legal regulatory framework and to provide guidance on any development, ensuring that the potential of any negative impact is avoided.

At Borownia Mining Field there are no buildings, nor planning allowed. There are only agricultural fields (and a road) between the two prominent surface segments of the component part of the mining field, whilst forest occupies the two segments of the mining field itself.

At Korycizna Mining Field, there is only forest; and forest in Poland is strictly protected.

At Gawroniec Settlement, currently (2017) there is agricultural activity only, but whilst local farmers own half of the land, a private investor who is also the owner of the local museum of porcelain owns the other half. Any development on Gawroniec Hill could be damaging to archaeological potential, and be visually intrusive on the open-space promontory so, in addition to monument protection, appropriate controls will be incorporated into the Management Plan (currently, 2018, in development).

The functional-spatial structure of the Krzemionki, Borownia and Korycizna mining fields is characterised by a predominance of forest, open agricultural land, and a dispersed settlement system with a predominance of low development areas. To the immediate north of Gawroniec Settlement the ribbon settlement of Ćmielów aligns with the main road and Kamienna River valley corridor. Gawroniec overlooks Ćmielów and it is unlikely that urban development there will negatively affect the values of the component part. However, within the buffer zone (setting) to the south, rolling rural views with little modern intrusion enhance the sense of place, so a control on development is necessary and will be incorporated into the Management Plan.

(ii) Environmental pressures
(e.g. pollution, climatic change, desertification)

Three component parts (the mining fields) of the nominated Property lie predominantly within forest on a lowland plain. The fourth (Gawroniec Settlement) is located on an open promontory on the edge of an upland plain overlooking the Kamienna River valley.

The underground system at Krzemionki Opatowskie Mining Field must be appropriately ventilated, and secured against collapse. The mines were abandoned in the early Bronze Age period, but on the whole the ground stability of the chamber mines, and pillar-chamber mines, is very good, being situated in the horizon of competent monolithic limestone.
Underground, in most places, the natural properties of the rock (hard limestone with sub-horizontal bedding, support pillars of natural rock left standing), together with man-made structural support (for example compacted back-fill from floor to ceiling in mined out voids) has been used to great effect and is durable and generally in good condition. Timber supports seemed not to have been used for structural purposes, rather only for stability of backfill, in which scenario the timber has long since degraded but does not pose a serious problem. Light subsidence is an issue, necessitating support measures ever since excavations have been made at Krzemionki Opatowskie Mining Field, and these interventions have improved with time in terms of quality and appropriateness. Examples of all phases survive and are retained to show visitors this aspect of the development of conservation. Tectonic movement is absent as Poland is stable.

These threats require a continued coherent policy by the authorities, including coordination of activities, systematic control and monitoring, maintenance of ventilation and security against collapses. The cooperation of specialists in these areas requires an appropriate ongoing financial resource, provided by ‘Krzemionki’ Archaeological Museum and Reserve, a division of Historical and Archaeological Museum in Ostrowiec Świętokrzyski. Details are available in the Management Plan.

(iii) Natural disasters and risk preparedness (earthquakes, floods, fires, etc.)

Forest areas in each of the three mining fields, can pose a potential fire threat but, if this does occur, the harm to the nominated Property will be of no negative impact, and temporary.

The scope of preparations to conduct rescue operations underground at Krzemionki Opatowskie Mining Field (rescue plan) is dealt with in the Management Plan. This covers rescue emergency, fulfilling the potential requirements foreseen by the rescue services in the underground mine workings and bringing immediate aid in case of threat to life or health of employees or other persons.

(iv) Responsible visitation at World Heritage sites

Among the component parts of the nominated Property, only Krzemionki Opatowskie Mining Field is available to visitors. This, however, is the principal mining field (representing over 90 per cent of striped flint exploited in prehistoric times), has the only excavated sites and only underground access. It has been developed for visitors for over 50 years, with substantial investment underground in the 1980s, ’90s, and early 2000s. A major museum, visitor, conference and educational complex, constructed outside the Property, was completed in 2012. Borownia and Korycizna mining fields are not accessible to visitors, and Gawroniec Settlement is on private land.

Among domestic tourists a significant segment comprises school groups from different levels of education. Among foreign tourists a marked predominance comprises visitors from the Czech Republic and Germany.
The peak of the visitor season is May–June.

Currently, the underground has substantial unused visitor capacity and may accept a larger number of people across the year, in particular there is a large capacity in the autumn-winter season, when weather conditions do not affect the comfort of visiting the underground. For safety and security reasons, the maximum number of visitors is carefully regulated at all times. Potentially, it is possible to extend underground routes to be made available for visitors (of varying categories), and to make the visit available to less-abled, including wheelchair users. With reference to surface components, there are no such limits, and availability depends only on management.

Shaft 4 is also available to visitors, but specialists only. On average, around 50 visitors, mostly specialist archaeologists and advanced students, are guided around this pristine chamber mine, per year. One radial communication gallery together with the entire perimeter sidewall gallery have been partially excavated to admit by crouching/crawling.

Visitor pressure, if uncontrolled, may negatively impact upon particular elements. Such visitor pressures may incur an unfavourable effect upon natural and cultural resources and sustainable development. Threats, which may result from visitors, include, *inter alia*:
- changes in the landscape resulting from the building of visitor facilities and transport infrastructure;
- degradation of the land surface, especially the prehistoric ‘industrial landscape’;
- reduction of water resources (visitor use on site);
- increase in waste;
- air pollution (emission from transport sources; significant emission of nitrogen, sulphur and carbon oxides into the atmosphere);
- increase in noise level.

Therefore, the Management Plan will take into account relevant aspects of the above in order to plan for an increased number of visitors, but to mitigate developmental pressure connected therewith with a simultaneous avoidance of unfavourable or negative impacts.

*Figure 179.* Interpretation deals with all property values (author K. Pęczalski).
### Visitor numbers to Krzemionki Opatowskie Mining Field

<table>
<thead>
<tr>
<th>Year</th>
<th>Visitors</th>
<th>Underground</th>
<th>Other</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2017</td>
<td>Domestic</td>
<td>17,811</td>
<td>1,155</td>
<td>19,017</td>
</tr>
<tr>
<td></td>
<td>Foreign</td>
<td>51</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>17,862</td>
<td></td>
<td>19,017</td>
</tr>
<tr>
<td>2016</td>
<td>Domestic</td>
<td>35,155</td>
<td>2,195</td>
<td>37,414</td>
</tr>
<tr>
<td></td>
<td>Foreign</td>
<td>64</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>35,219</td>
<td></td>
<td>37,414</td>
</tr>
<tr>
<td>2015</td>
<td>Domestic</td>
<td>30,955</td>
<td>1,044</td>
<td>32,152</td>
</tr>
<tr>
<td></td>
<td>Foreign</td>
<td>153</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>31,108</td>
<td></td>
<td>32,152</td>
</tr>
<tr>
<td>2014</td>
<td>Domestic</td>
<td>33,123</td>
<td>1,824</td>
<td>35,106</td>
</tr>
<tr>
<td></td>
<td>Foreign</td>
<td>159</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>33,282</td>
<td></td>
<td>35,106</td>
</tr>
<tr>
<td>2013</td>
<td>Domestic</td>
<td>33,067</td>
<td>1,512</td>
<td>34,580</td>
</tr>
<tr>
<td></td>
<td>Foreign</td>
<td>76</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>33,143</td>
<td></td>
<td>34,580</td>
</tr>
<tr>
<td>2012</td>
<td>Domestic</td>
<td></td>
<td></td>
<td>34,760</td>
</tr>
<tr>
<td></td>
<td>Foreign</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td></td>
<td></td>
<td>34,760</td>
</tr>
<tr>
<td>2011</td>
<td>Domestic</td>
<td></td>
<td></td>
<td>38,209</td>
</tr>
<tr>
<td></td>
<td>Foreign</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td></td>
<td></td>
<td>38,209</td>
</tr>
<tr>
<td>2010</td>
<td>Domestic</td>
<td></td>
<td></td>
<td>39,117</td>
</tr>
<tr>
<td></td>
<td>Foreign</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td></td>
<td></td>
<td>39,117</td>
</tr>
</tbody>
</table>

(v) Number of inhabitants within the Property and the buffer zone

<table>
<thead>
<tr>
<th>Id</th>
<th>Name of the component part</th>
<th>Nominated Property</th>
<th>Buffer zone (estimation)</th>
</tr>
</thead>
<tbody>
<tr>
<td>K1</td>
<td>Krzemionki Opatowskie Mining Field</td>
<td>0</td>
<td>400</td>
</tr>
<tr>
<td>K2</td>
<td>Borownia Mining Field</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>K3</td>
<td>Korycizna Mining Field</td>
<td>0</td>
<td>50</td>
</tr>
<tr>
<td>K4</td>
<td>Gawroniec Settlement</td>
<td>0</td>
<td>1000</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>0</td>
<td>1450</td>
</tr>
</tbody>
</table>
5. Protection and Management of the Property
5. Protection and Management of the Property
Protection and Management of the Property

(author A. Jedynak)
5.a Ownership

The underground spaces of the prehistoric mines are the property of the State Treasury. Organised underground visitor routes at Krzemionki Opatowskie Mining Field are administered by the ‘Krzemionki’ Archaeological Museum and Reserve (Muzeum Archeologiczne i Rezerwat ‘Krzemionki’, division of Muzeum Historyczno – Archeologicznego w Ostrowcu Świętokrzyskim), and also to shaft 4/606 (for specialists, on average around 50 visitors per year).

In the case of land and facilities on the ground, the ownership is as follows:

<table>
<thead>
<tr>
<th>Id</th>
<th>Name of the component part</th>
<th>Nominated Property</th>
<th>Public</th>
<th>Private (individual owners)</th>
</tr>
</thead>
<tbody>
<tr>
<td>K1</td>
<td>Krzemionki Opatowskie Mining Field</td>
<td>311.3 ha</td>
<td>309.02 ha / 99.27%</td>
<td>2.28 ha / 0.73%</td>
</tr>
<tr>
<td>K2</td>
<td>Borownia Mining Field</td>
<td>11.6 ha</td>
<td>6.32 ha / 54.34%</td>
<td>5.31 ha / 45.66%</td>
</tr>
<tr>
<td>K3</td>
<td>Korycizna Mining Field</td>
<td>9.9 ha</td>
<td>1.9 ha / 19.2%</td>
<td>7.99 ha / 80.8%</td>
</tr>
<tr>
<td>K4</td>
<td>Gawroniec Settlement</td>
<td>16.4 ha</td>
<td>0.63 ha / 3.86%</td>
<td>15.77 ha / 96.14%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>349.2 ha</strong></td>
<td><strong>317.87 ha / 91.03 %</strong></td>
<td><strong>31.35 ha / 8.97%</strong></td>
<td></td>
</tr>
</tbody>
</table>

A buffer zone on the land surface surrounds each component part. Ownership of this land, which covers an area of 1828.7 ha, is more diverse and ownership comprises multiple private and State owners.

Administrative affiliation

<table>
<thead>
<tr>
<th>Id</th>
<th>Name of the component part</th>
<th>District (powiat)</th>
<th>Gmina (commune)</th>
<th>Village/ town</th>
</tr>
</thead>
<tbody>
<tr>
<td>K1</td>
<td>Krzemionki Opatowskie Mining Field</td>
<td>ostrowiecki</td>
<td>Bodzechów</td>
<td>Sudół</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Ćmielów</td>
<td>Stare Stoki, Ruda Kościelna</td>
</tr>
<tr>
<td>K2</td>
<td>Borownia Mining Field</td>
<td>ostrowiecki</td>
<td>Ćmielów</td>
<td>Ruda Kościenla</td>
</tr>
<tr>
<td>K3</td>
<td>Korycizna Mining Field</td>
<td>ostrowiecki</td>
<td>Ćmielów</td>
<td>Ruda Kościenla</td>
</tr>
<tr>
<td>K4</td>
<td>Gawroniec Settlement</td>
<td>ostrowiecki</td>
<td>Ćmielów</td>
<td>Wojciechówka</td>
</tr>
<tr>
<td></td>
<td></td>
<td>opatowski</td>
<td>Ożarów</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Id</td>
<td>Name of the component part</td>
<td>Ownership</td>
<td>Administration</td>
<td></td>
</tr>
<tr>
<td>-----</td>
<td>------------------------------------</td>
<td>-------------------------------</td>
<td>----------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>K1</td>
<td>Krzemionki Opatowskie Mining Field</td>
<td>Individual private owners (7 plots)</td>
<td>Muzeum Historyczno-Archeologiczne w Ostrowcu Św. [Historical and Archaeological Museum in Ostrowiec Św.] (perpetual usufruct)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Individual private owners (7 plots)</td>
<td>Muzeum Historyczno-Archeologiczne w Ostrowcu Św. [Historical and Archaeological Museum in Ostrowiec Św.] (usufruct)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Individual private owners (7 plots)</td>
<td>Lasy Państwowe Nadleśnictwo Ostrowiec Św. [State Forests, Forest District Ostrowiec Św.] (in administration)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Individual private owners (7 plots)</td>
<td>Urząd Miasta i Gminy Ćmielów [Municipality and the Communal Office of Ćmielów] (usufruct)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Individual private owners (7 plots)</td>
<td>Urząd Miasta i Gminy Ćmielów oraz Rezerwat Archeologiczny Kielce [Municipality and the Communal Office of Ćmielów and the Kielce Archaeological Reserve]</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Individual private owners (7 plots)</td>
<td>Bodzechów Commune</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Individual private owners (7 plots)</td>
<td>Ćmielów Commune</td>
<td></td>
</tr>
<tr>
<td>K2</td>
<td>Borownia Mining Field</td>
<td>Individual private owners (5 plots)</td>
<td>Lasy Państwowe Nadleśnictwo Ostrowiec Św. [State Forests, Forest District Ostrowiec Św.] (in administration)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Individual private owners (5 plots)</td>
<td>Urząd Miasta i Gminy Ćmielów [Municipality and the Communal office of Ćmielów] (usufruct)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Individual private owners (5 plots)</td>
<td>Skarb Państwa – Agencja Nieruchomości Rolnych Oddział w Rzeszowie [State Treasury – Agricultural Property Agency – Rzeszów Branch]</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Individual private owners (5 plots)</td>
<td>Ostrowiec District (in administration)</td>
<td></td>
</tr>
<tr>
<td>K3</td>
<td>Koryczna Mining Field</td>
<td>Individual private owners (12 plots)</td>
<td>Lasy Państwowe Nadleśnictwo Ostrowiec Św. [State Forests, Forest district Ostrowiec Św.] (in administration)</td>
<td></td>
</tr>
<tr>
<td>K4</td>
<td>Gawroniec Settlement</td>
<td>Individual private owners (38 plots)</td>
<td>Urząd Miasta i Gminy Ćmielów [Municipality and the Communal Office of Ćmielów] (usufruct)</td>
<td></td>
</tr>
</tbody>
</table>
5.b Protective Designation

The nominated Property is a subject to protection pursuant to several independent, yet complementary legal regulation systems. The important features of the current principles and forms of protection of the nominated Property are the relationship between the systems of protection of cultural and natural heritage, and overlapping forms of protection that build a solid foundation for the creation and implementation of a comprehensive, multidimensional and participatory management plan (2009–2018, under development), where cultural heritage and landscape will form the main focus of the management.

<table>
<thead>
<tr>
<th>Id</th>
<th>Name of the component part</th>
<th>Culture</th>
<th>Nature</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Krzemionki – Neolith era flint mines, located in Sudół village in Bodzechów commune Regulation of the President of the Republic of Poland of 8 September 1994, the Official Journal of the Republic of Poland ‘Monitor Polski’ no. 50 item 419</td>
<td></td>
<td>The area of protected landscape of the Kamienna river valley Resolution no. XXXV/617/13 of the Regional Council of Świętokrzyskie Voivodeship of 23 September 2013 on designation of the area of protected landscape of the Kamienna river valley (Journal of Laws of Świętokrz. Voivodeship item 3309)</td>
</tr>
<tr>
<td>K2</td>
<td>Borownia Mining Field</td>
<td>Entry into the Register of monuments of Świętokrzyskie voivodeship Register of monuments no. A 260, 15.09.1981</td>
<td></td>
</tr>
<tr>
<td>K3</td>
<td>Korycizna Mining Field</td>
<td>Entry into the Register of monuments of Świętokrzyskie voivodeship Register of monuments no. A 265, 15.07.1982</td>
<td></td>
</tr>
<tr>
<td>K4</td>
<td>Gawroniec Settlement</td>
<td>Entry into the Register of monuments under procedure, foreseen to be finalised in 2018</td>
<td></td>
</tr>
</tbody>
</table>
National Memorial of History

Krzemionki memorial of history (Pol: pomnik historii) – Neolithic flint mines, located in Sudół village in Bodzechów commune, established by the Regulation of the President of the Republic of Poland of 8 September 1994, the Official Journal of the Republic of Poland ‘Monitor Polski’ no. 50 item 419.

The aim of establishing the memorial of history was to preserve the complex of excavation pits, shafts and underground environment linked with prehistorical mining due to its unique worldwide archaeological value as well as for scientific, educational and touristic purposes.

Annex 2, attachment no. 1

Registry of Monuments of Świętokrzyskie Voivodeship

**Krzemionki**

Register number A1 / 499/1Aa

Globally recognised for many decades, this unique site was declared a monument 28 September 1945, and subsequently entered into the Register of Monuments in 1967. The decision was renewed in 1986. The ‘Krzemionki’ Archaeological reserve covering flint mine from the Late Stone Age (Neolithic) and the Early Bronze Age became legally protected and no changes were allowed to be introduced to the existing condition.

Annex 2, attachment no. 2

**Borownia**

Register number A 260

The remains of prehistoric striped flint mine ‘Borownia’ in Ruda Kościelna has been listed in the Register of Monuments for its unique value which lies in the well-preserved prehistoric ‘industrial’ landscape of the mining field and of the settlement of Funnel Beaker and Mierzanowicka Culture neighbouring the mine.

Annex 2, attachment no. 3

**Koryczna**

Register number 265 A

The justification of the decision to enter the ‘Koryczna’ striped flint mine in Wojciechówka village on the Register of Monuments underlined that, together with its neighbouring workshops above
the ground, it is a part of the so-called Wysokolysogórski Flint Exploitation District, which is one of the biggest and most interesting complexes of prehistoric mining in the region. The mine is associated with the population of Mierzanowicka Culture of the Early Bronze Age. Additionally, the mine area includes a well-preserved prehistoric ‘industrial’ landscape of the mining field.

Annex 2, attachment no. 4

Natura 2000 Sites

Krzemionki Opatowskie
Natura 2000 Site of Community Importance (SCI) established in March 2011 PLH 260024

Characteristics of the area: The area is located in the Przedgórze Iłżeckie mesoregion and it consists mainly of forests, including *inter alia*, pine and mixed forests as well as oak-hornbeam and oak woods. Small areas are covered with secondary xerothermic grasslands which overgrow the post-mining land of the flint mine [Krzemionki Opatowskie, K1 component] and the area of abandoned limestone quarries. The area stretches over a mostly flat denudation plain, consisting in the large part of Jurassic limestones covered by a thin layer of sandy and sandy-clay Pleistocene sediments. In its northern part one may find sinkholes, erosive valleys and anthropogenic surface deformations in the form of old excavation pits and quarries. The entire area is dry, devoid of water tanks or water courses.

The importance and main goals of protection: The area is covered with quite large oak-hornbeam and oak forests. The remaining tree stands serve mainly household purposes and include, *inter alia*, subcontinental Peucedano-Pinetum forest and suboceanic forest Leucobyro-Pinetum, representing the basic elements of the phytocoenosis. In total, three different types of habitats (according to the annex to the I Habitat Directive) covering more than 16% of the surface have been found here. Within the vascular plants flora, one may distinguish a large group of relict, rare and endangered species. There are six species which are listed in the Polish Plant Red Data Book, including: *Daphne cneorum*, *Cerasus fruticosa*, *Festuca amethystina subsp. ritschlii*, *Cephalanthera rubra*; and two plant species listed in the annex to the II Habitat Directive: *Adenophora liliifolia* and *Cypripedium calceolus*. The main protection goal is to focus, from among the recognised habitats, mainly on the priority habitat of well-preserved stenothermic oaks. These owe their great value to their species composition, which influences biological diversity on the level of species in the region and the entire country. These sorts of habitats are also home of nature species, in this case: of a few abundant and present for several decades populations of *Adenphora liliifolia* and less numerous yet stable populations of *Cypripedium calceolus*. The area includes as well the habitat of the hermit beetle *Osmoderma eremita* (in Krzemionki Opatowskie, K1 component). The area gives shelter to relict, rare and endangered species, such as: *Coronella austriaca*, *Mantis religiosa*, *Scolia hirta*, *Iphiclides podalirius*, *Papilio machaon*, *Apatura ilia*, *Carabus inricatus*, *Chondrula tridens*, *Nesovitrea petronella*. There are also species of birds listed in the Annex I to the Council
5. Protection and Management of the Property

Directive 79/409.EEC, namely: *Dendrocopos syriacus, Dendrocopos medius, Lanius collurio, Lullula arborea* and *Sylvia nisoria.*


1. Natural habitats:
   - 6210 Xerothermic grasslands (*Festuco-Brometea* and thermophilous grasslands *Asplenion septentrionalis Festucion pallentis*)
   - 9170 Oak-hornbeam and linden-oak-hornbeam forests (*Galio-Carpinetum, Tilio-Carpinetum*)
   - 9110 Thermophilous oak forests (*Quercetalia pubescenti petraeae*)

2. Plant species:
   - 4068 Ladybells *Adenophora liliifolia*
   - 1902 Lady’s-slipper orchid *Cypripedium calceolus*

A conservation management/action plan has been developed for the Natura 2000 area.

Annex 2, attachment no. 6

**Dolina Kamiennej**

Natura 2000 Site of Community Importance (SCI) established in March 2011 r. PLH 260019

Characteristics of the area:
The area is located in the Przedgórze Iłżeckie mesoregion. It stretches over the vast Kamienna river valley, a classic denudation plain, whose highest points rarely exceed 200 m above sea level. Starting from Ćmielów, the Kamienna river flows northbound in the fault depression where it creates two picturesque faults, first in Podgrodzie [within the borders of K2 component] and the second one in Báltów. This area is characterised by sharp loess and limestone edges cut by numerous limestone outcrops, canyons, caves and ravines. Built of limestone constituting the Mesozoic border of the Świętokrzyskie Mountains as well of formations dating back to Middle and Late Jurassic, and lithology from the Cretaceous period, the area is distinguished by elevations and edges falling steeply towards the river. The river valley undergoes surges, it is vast, with plenty of oxbows and isolated still abandoned meander pools. It is dominated by extensively exploited grasslands of varied moisture as well as flood-meadows, willow bushes and, more rarely, lowland bogs. The edges and slopes of the valley are covered with well-formed xerothermic grasslands. Additionally, the landscape is diversified by dunes and numerous karst craters. From the northern fault the Kamienna river turns towards the north and flows into the Vistula river.

The importance and main goals of protection:
The area has a very diverse and rich flora thanks to diversified bedrock, landscape, soil and human activity. The oligotrophic, loam sandy habitats are overgrown with fresh pine woods and mixed forests. On the loess soils, especially at the slopes of the Kamienna river valley, there have preserved fragments of rich oak-hornbeam forests with rare and legally protected plants such as: *Aconitum moldawicum, A.variegatum, Omphalodes scorpioides, Lathyrus laevigatus.* The forest reserves of Modrzewie, Ulów and Lisiny Bodzechowskie are also of significant natural significance. 13 types of natural habitats listed in Annex I of Habitat Directive covering more than 42% of the surface have been found here. The most valuable ones are xerothermic grasslands, *inter alia* saxicolous and stipsa, with many precious and endangered species (such as: *Carex pediformis, Stipa*
pulcherrima, S. joannis, Iris aphyll), meadows with various moisture level, oak-hornbeam forests and oxbows as well as small fragment of oak-elm-ash floodplain forests. Furthermore, the fact that the area is home to one of the largest and quite stable populations of *Cypripedium calceolus* additionally increases its importance. It also provides a shelter for animal species listed in II annex of Habitat Directive, such as: *Barbastella barbastellus, Castor fiber, Lutra lutra, Triturus cristatus, Bombina bombina, Aspius aspius, Ophiogomphus cecilia, Maculinea teleius (Phengaris teleius), Lycaena dispar* and *Osmotherma eremita*. In the case of the last species the area is especially important as it offers protection for its two very well-preserved natural habitats: Lisiny Bodzechowskie and Ulów. Furthermore, the population of amphibia is very large.

The natural character of the river and floodplains situated on the Jurassic carbonate limestones between Ostrowiec and Ćmielów are convenient habitat of molluscs. The flat land and a peaceful river flow enabled creation of lasting water ponds and floodplains covered by water with sedges and cattails. These conditions are very favourable for species such as *Vertigo angustior* and *Vertigo moulinsiana*. The Kamienna river valley is an important nesting place of the following species: *Aquila pomarina, Tring totanus, Gallinago gallinago, Crex crex* and *Rallus aquaticus*. Additionally, *Scolia hirta, Mantis religiosa* and *Coronella austriaca* can be found in large numbers on the surrounding xerothermic grasslands.

It must be underlined that the Kamienna river valley is an important, nationally recognised ecological corridor. With its faults, numerous rock exposures, caves and deep ravines the valley is also a scenic landscape.

A conservation management plan has been prepared for the area.

Annex 2, attachment no. 7

### Nature Reserve

**Krzemionki Opatowskie Nature Reserve**

Order of the Minister of Environmental Protection, Natural Resources and Forestry of 27 June 1995; the Official Journal of the Republic of Poland ‘Monitor Polski’ no. 33 of 1995 item 396.

The 378.81 ha inanimate nature reserve was established in 1995. It is a partial reserve, and its aim is to preserve rare and protected plant species (*inter alia* a very rare garland flower Daphne cneorum) as well as the striped flint mine, mining pits and remains of mining camps. A conservation management plan has been prepared for the reserve.

Annex 2, attachment no. 8
Area of Protected Landscape

The Area of Protected Landscape of the Kamienna River Valley
Regulation no. 12/95 of the Governor of Kielce province of 29 September 1995 r., (Journal of Laws of Kieleckie Voivodeship no. 21 item 145.)

The protected landscape extends over an area of 733.76 km² in total. It covers a part of Iłżecka forest (Puszcza Iłżecka) and the Kamienna river basin. It aims to protect ecosystems within its borders. The most important ecological goal is to protect the water reservoirs both under and above the ground as well as the valley of Kamienna river which is a significant ecological corridor. Additionally, the protected area plays an important role in shaping local climate and aerosanitary conditions.

The applicable legal basis is the Resolution no. XXXV/617/13 of the regional Council in Świętokrzyskie Voivodeship of 23 September 2013 on designation of the Area of Protected Landscape of the Kamienna River Valley (Journal of Laws of Świętokrzyskie Voivodeship item 3309).

Annex 2, attachment no. 9

The abundance of cultural heritage sites in the Świętokrzyskie Province constitutes a decisive ingredient of the cultural identity among the region’s inhabitants; and further creates an opportunity of using this asset to promote the socio-economic development of the region and its touristic qualities. A special role is played here by unique sites of European and world significance – and recognition – of which Krzemionki undoubtedly exemplifies.

Adam Jarubas
Świętokrzyskie Province Marshall
5. Protection and management of the property

<table>
<thead>
<tr>
<th>NOMINATED PROPERTY</th>
<th>PROPOSED BUFFER ZONE</th>
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<td>KRZEMIONKI Prehistoric Striped Flint Mining Region</td>
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Register of Monuments
Nature Reserve
Monument of History
NATURA 2000
Kamienna Valley Protected Landscape Area

Print map scale 1:10000 at A2 layout format
Base map: ISOK geoportal.gov.pl by: NID World Heritage Unit date Oct-2017
5. Protection and Management of the Property

GAWRONIEC SETTLEMENT

NOMINATED PROPERTY

Prehistoric Striped Flint Mining Region

KRZEMIONKI

NATURA 2000

base map: ISOK geoportal.gov.pl   by: NID World Heritage Unit   date: Oct-2017

print map scale 1 : 18500 at A2 signal format

light grey: GAWRONIEC SETTLEMENT
KRZEMIONKI
Prehistoric Striped Flint Mining Region

Register of Monuments

KORYCZNA MINING FIELD

component no. component name

Print map scale 1 : 10000 at A3 layout format.
Base map: ISOK geoportal.gov.pl by NID World Heritage Unit: date: Oct-2017
5. Means of Implementing Protective Measures

The nominated Property is subject to protection pursuant to several independent, yet complementary, legal regulations. The important features of the current principles and forms of protection of the nominated Property are on the one hand the relationship between the protection of natural and cultural heritage, and on the other overlapping forms of protection that build a solid foundation for the creation and implementation of a comprehensive, multidimensional and participatory management plan.

Protection of Monuments and Cultural Heritage

The Act on protection and care of historical monuments (Act of 23 July 2003, Journal of Laws of 2003, No. 162, item 1568, as amended) specifies the purpose, scope and forms of protection of monuments and the care for them, the principles of establishment of a national programme for the protection of monuments and care of monuments and the financing of conservation, restoration and other works at the monuments, as well as the organisation of monument protection authorities.

According to the Act, a monument (Pol: zabytek) is a property (real estate) or a movable cultural item, their parts or ensemble being the work of humans, or connected with their activity, and constituting a testimony of the past epoch or event, the preservation of which is in the social interest because of historical, artistic, or scientific value.

Protection of monuments, in particular, consists in taking action by the government bodies to:
1) provide legal, organisational and financial information in order to allow permanent conservation of monuments, their development and maintenance;
2) prevent risks that could cause damage to the monuments’ value;
3) prevent destruction and misuse of the monuments;
4) prevent theft, loss or illicit export of monuments abroad;
5) control the state of preservation and purpose of monuments;
6) take into account the protection tasks in spatial planning and development and in shaping the environment.

Monument care exercised by the owner or holder is, in particular, to ensure the conditions for:
1) scientific research and documentation of the monument;
2) conservation, restoration and construction works at the monument;
3) protection and maintenance of the monument and its surroundings in the best possible condition;
4) use of a monument in a way that ensures permanent preservation of its value; 
5) promotion and dissemination of knowledge on the monument and its significance for the 
history and culture.

Protection and care shall cover, regardless of the state of preservation, immovable monuments 
(including cultural landscapes), mobile monuments, and archaeological sites, in particular: 
a) the terrain remains of prehistoric and historical settlement; 
b) graveyards; 
c) barrows; 
d) the relics of economic, religious and artistic activity.

The legal forms of protection established by the current system is as follows: 
• entries in the register of monuments; 
• recognition as a national memorial of history (Pol: pomnik historii); 
• establishment of a cultural park; 
• local preservation agreement in the matter of spatial development, or in the decisions 
concerning localisation of public investments, building conditions, privilege to deliver road 
investment, localisation of railways, or consent to build a local public airport.

Forms of legal protection relevant to the nominated Property

Register of monuments

Entry in the register is the basic form of protecting monuments. Administrative actions in 
the field of the monuments’ entry in the register of monuments are carried out by the 
Provincial Conservation Officer who, ex officio or at the request of a party – the monument’s 
owner or user, launches the entry procedure. The preparatory stage consists in collection of 
information and documentary materials meant to confirm the value of the monument for the 
national heritage.

For the monuments located in a particular voivodeship, the register of monuments is managed 
by the Provincial Conservation Officer. Separate books are kept for immobile, mobile and 
archeological monuments.

National memorial of history

A national memorial of history can mean any immovable monument listed in the register or 
a cultural park of special cultural value. The importance of national memorial of history is 
highlighted by the fact that it is instituted by the President of the Republic of Poland by special 
regulation issued at the request of the Minister of Culture and National Heritage. The contents 
of the Presidential regulation list the characteristics of the monument, state its value and define 
its borders. Recognition as a national memorial of history is a form of ennoblement raising 
its status and does not imply any additional legal effects. Obtaining this status is a necessary 
condition required for a monument to be nominated for the UNESCO World Heritage List.
Cultural park

A cultural park is created to protect the cultural landscape and preserve some outstanding landscape areas with immovable monuments that characteristically showcase local construction tradition and settlement. The decision to set up a cultural park is taken by the municipal council, after consulting the Provincial Conservation Officer competent for the territory. There must be a local spatial development plan prepared for each cultural park. In addition, a protection plan may also be prepared and the protected area management unit appointed. Prohibitions and restrictions may be established for the entire cultural park or its part concerning the following issues:
1) carrying out construction works and industrial, agriculture, cultural, trade or service activities;
2) changing the use of immovable monuments;
3) placing boards, inscriptions, advertising and other signs not related to security of the cultural park, with the exception of road signs and signs related to the protection of public order and safety (with reservations);
4) installing waste disposal or storage.

Establishment of conservation protection zones in planning documents

The Act on the protection and care of monuments provides a basis for establishing conservation protection zones in the studies of conditions and directions of spatial development and local spatial development plans. Depending on the needs, the zone should cover the areas on which the limitations, prohibitions and injunctions included in the arrangements of the plan apply to protect the monuments located in the area concerned.

Protection of monuments which are located in the commune area is the duty of the local government. The commune is mandated to: ‘secure legal, organisational and financial conditions which will ensure the constant condition of the monument and its protection’ and to prevent ‘threats which have the potential to decrease the monument’s value’. One of the commune’s specific duties defined in the government act is ‘acknowledgement of the preservation tasks during spatial development planning in the voivodeship’. Every commune is obligated to provide a monument’s record (inventory). The commune governor (mayor, city president) keeps a monuments inventory, a collection of individual record cards for each monument located in the commune area.

When the monument is listed on the commune’s monuments inventory, the conservation office should be consulted on every decision. These decisions include: assessment of public investment localisation, decision on land development conditions (in line with the Act on planning and spatial development) and duty to give or decline a building permit according to the Building Law. Those decisions should be made by the building administration board.

The commune inventory is a document which should be updated as needed.
Strategic documents and programmes

A Programme for the care of monuments is a kind of strategic document prepared by the local authorities on the level of voidodeship, district and commune. The legal / statutory goal of the programmes is:

- Including issues of protection of historical monuments into a system of strategic tasks, resulting from the concept of the country spatial management;
- Considering conditions for the protection of monuments, including cultural landscape, archaeological heritage as well as determinants of natural protection and ecological balance;
- Stopping the process of degradation of monuments and improving their state of conservation;
- Exposing individual monuments and qualities of cultural landscape;
- Undertaking actions aiming to improve attractiveness of monuments for social, touristic and educational purposes and supporting initiatives which encourage funding for care of monuments;
- Setting terms of cooperation with owners of monuments in such a way as to eliminate conflicts associated with use of monuments;
- Undertaking actions which enable creating jobs related to care of monuments.

A Program for the care of monuments is prepared for four years. Voivodeship, district and commune programmes for the care of monuments are taken into account when preparing studies of conditions and directions of spatial development and spatial development plans for voivodeships and districts.

Cultural heritage protection authorities and institutions

Pursuant to the Act the heritage protection authorities include:

1. the Minister of Culture and National Heritage, on behalf of whom the tasks and purview related to protection of historic monuments are exercised by the General Conservator of Monuments, who holds the position of Secretary or Undersecretary of State in the Ministry of Culture;

2. the Voivodeship Governor, whose tasks and purview within the aforesaid scope are exercised by the Provincial (Voivodeship) Conservation Officer, who manages the Provincial Heritage Authority. At the request of the Provincial Conservator of Monuments, and after consulting the General Conservator of Monuments, the Provincial Governor also has the right to establish and close agencies of the Voivodeship Heritage Authority.
5. Protection and management of the property

**Provincial Conservator of Monuments**

The Provincial Conservator of Monuments, who is a member of the joint provincial administration, is the first instance body, whilst the Minister of Culture is the second instance body in the matters specified in the Act and in separate regulations. The tasks of the Provincial Conservator of Monuments include, in particular:

1. carrying out duties arising from the National Heritage Preservation and Protection Programme;
2. preparing plans for financing monument preservation and protection from granted funds;
3. maintaining the Heritage Register and Provincial Heritage Inventory, and collating relevant documentation;
4. issuing, in keeping with decisions and resolutions, licences concerning the issues specified in the Act and separate regulations;
5. supervising and carrying out quality control of conducted conservation studies, architectural research, conservation, restoration and construction works and other activities related to monuments, as well as archaeological research;
6. preparing provincial heritage protection plans in the event of armed conflict and crisis;
7. promoting knowledge about monuments.

**National Heritage Board of Poland**

At the request of the General Conservator of Monuments, the Minister of Culture and National Heritage can entrust the execution of some tasks which fall within his or her remit (except for the issuing of administrative decisions) to managers of cultural institutions specialising in monument protection, for which the Minister of Culture and National Heritage is the organiser. The said institutions include the National Heritage Board of Poland (Narodowy Instytut Dziedzictwa).

The primary objectives of the National Heritage Board of Poland are to identify, study and document heritage assets, gather information related to the historic environment, cultural landscape and cultural monuments, develop policies and strategies on historic environment conservation and raise public awareness of the historic environment, cultural landscapes and heritage assets. The Board has its headquarters in Warsaw and 16 regional offices around the country. In the case of World Heritage properties, the Director of the National Heritage Board of Poland has a mandate to act on behalf of the General Conservator of Monuments.
Protection of Natural Heritage

Nature is part of our national heritage and wealth. Taking care of it is the duty of public authorities, legal persons and other organisational units, and citizens. The principles of its protection are determined primarily by the Act on Nature Conservation of 16 April 2004 (Journal of Laws of 2004, No. 92, item 880).

According to the Act, nature protection consists of maintaining, sustainable utilisation and renovation of resources, objects and components of wildlife such as wild plants, animals and fungi, plants, protected species of animals and fungi, wandering and migratory animals, natural habitats, endangered habitats, rare and protected species of plants, animals and fungi, objects of animate and inanimate nature, and fossil remains of plants and animals, landscape, greenery in cities and villages, and woodlots.

The purpose of nature protection, is as follows:
1) maintaining ecological processes and ecosystem stability;
2) preserving biodiversity;
3) preserving the geological and palaeontological heritage;
4) ensuring continuity of species of plants, animals and fungi, and their habitats, by maintaining or restoring favourable protection status;
5) protecting landscape features, greenery in towns and villages and woodlots;
6) maintaining or restoration of the proper status of protection of natural habitats, as well as other wildlife resources, objects and components;
7) forming the right human attitudes towards nature through education, information and promotion in the field of protection of the nature.

Nature protection targets are reached by:
• taking into account the requirements of nature protection strategies, programs and programming documents referred to in Article 14(1) of the Act of 27 April 2001 Environmental Protection Law (Journal of Laws of 2013, item 1232, as amended), environmental programs adopted by local government bodies, the concept of national spatial planning, voivodeship development strategies, voivodeship spatial development plans, municipal development strategies, studies of conditions and directions of spatial development of municipalities, local spatial development plans and development plans of internal sea waters, territorial sea and exclusive economic zone and in business and investment;
• covering wildlife resources, objects and components with forms of nature protection;
• developing and implementing provisions of protection plans for areas protected by law, programs to protect species, habitats and migration routes of protected species, implementation of protection programmes and sustainable use of biological diversity with a plan of action;
• conducting educational activities, information and promotion in the field of nature protection;
• conducting research on issues related to nature protection.

The Act provides for the legal forms of protection and defines the forms of protective measures, namely strict, partial and landscape protection. Protective measures can be
passive or active – involving the use, if necessary, of protective treatments to restore the natural condition of ecosystems and elements of nature or to preserve natural habitats and the habitats of plants, animals and fungi. The Nature Conservation Act defines 10 forms of nature protection. There are the following forms within the borders of the nominated World Heritage Property and the proposed buffer zone:

**Forms of legal protection relevant to the nominated Property**

**Nature reserve**

A nature reserve covers areas preserved in natural or slightly changed condition, with outstanding environmental, scientific, cultural or landscape values. Recognition of areas as a nature reserve takes place by an act of local law in the form of an order of the regional director for environmental protection. The act specifies the area’s name, location, and the boundary line and the buffer zone, the objectives of protection and the nature, type and subtype of nature reserve as well as the person supervising the reserve.

Draft studies of conditions and directions of spatial development of municipalities, local spatial development plans, provincial spatial development plans in the part concerning the nature reserve and its buffer zone, have to be agreed upon with the regional director of environmental protection in the field of arrangements of these plans which could have a negative impact on the protection objectives of a nature reserve. Also, draft forest management plans, simplified forest management plans and tasks in the field of forestry in the part concerning the nature reserve buffer zone have to be approved by the regional director of environmental protection in the matter of arrangements of these plans or tasks that could have a negative impact on the protection of the nature reserve.

Nature reserves, next to national parks, constitute the most important link in the system of legal protection of nature in Poland. Establishing a reserve is a public goal within the meaning of the Act of 21 August 1997 on real estate management (Journal of Laws of 2004, No. 261, item 2603, as amended). It is created in the areas owned by the State Treasury (in the case of private property – expropriation takes place).

Within the reserve, it is prohibited *inter alia* to capture or kill wild animals, collect or destroy eggs, juvenile and developing forms of animals, deliberately disturb vertebrate animals, collect antlers, destroy burrows, nests, dens and other animal shelters and their breeding sites; hunt, except in areas designated in the plan of protection or protection tasks set for the nature reserve; capture, destroy or wilfully damage plants and fungi; use, destroy, wilfully damage, pollute and alter natural objects, sites and resources, wildlife formations and components; change water relations, regulation of rivers or streams unless these changes serve to protect wildlife; acquire rocks, including peat, and fossils, including the fossil remains of plants and animals, minerals and amber; destroy soil or change the land purpose and use; go walking, cycling, skiing and horseback riding, with the exception of hiking and skiing routes designated by the regional director of environmental protection; move in vehicles off public roads and roads specified by the regional director of environmental protection; carry out earth works permanently disfiguring the terrain.
The regional director for environmental protection may authorise derogations from the prohibitions in the nature reserve in case it is justified and does not have an adverse impact on the nature reserve protection objectives. There are protection plans drawn up and implemented for nature reserves. The plan, covering a period of 20 years, is prepared by the regional director of environmental protection or, upon agreement with this body, by the entity managing or supervising the reserve. In the process of drafting, it is necessary to ensure public participation (public consultation). The draft requires the opinion of the competent local municipal councils.

Natura 2000 sites

Natura 2000 sites are established in all Member States, forming the European Ecological Network Natura 2000. The aim is to legally protect approximately 200 of the most valuable and endangered habitats and over 1,000 rare and endangered species. The uniqueness of this form of nature protection consists in the fact that Member States form a network based on the same assumptions set out in the law and the guidelines of the European Union, they manage it using similar instruments, they care together for adequate funding and its promotion. Natura 2000 sites include Special Protection Areas and Special Areas of Conservation. The following EU directives are the basis for the designation and operation of the Natura 2000 sites:

- Directive 2009/147/EC of 30 November 2009 on the conservation of wild birds, which is the consolidated version of the earlier Directive 79/409/EEC of 2 April 1979 on the conservation of wild birds;
- Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora, which forms part of European Union law.

Natura 2000 site designation, change of its boundaries or removal takes place in consultation with the ministers responsible for agriculture, rural development and water management, by ordinance of the minister responsible for the environment which specifies the name, administrative location, area and the map of the area, the purpose and object of protection and the area supervisor. When adopting the ordinance, the minister responsible for the environment, considers the actual condition of natural habitats and species of plants and animals. Special Areas of Conservation are designated by the minister of the environment after consultation with the European Commission.

Guided by the need to preserve and restore the proper protection status of habitats and species of plants and animals that the Natura 2000 site was designated to protect, the regional director of environmental protection establishes a plan of protection tasks for the Natura 2000 site for a 10-year period by local law act in the form of an order. The plan of protection tasks can be changed if it results from the need to protect these habitats or species of plants and animals. The plan of protective tasks is not drawn up inter alia for the areas which are managed by the forest district and are covered by a forest management plan. In such a situation, the forest management plan becomes a plan of protection for this part of the Natura 2000 site.
The General Director of Environmental Protection oversees the functioning of Natura 2000 sites, including exercising control of the implementation arrangements of the management plans for Natura 2000 sites. The regional director of environmental protection coordinates the functioning of the Natura 2000 sites in his area of operation. In the area managed by the National Forest Holding ‘State Forests’ located in the Natura 2000 site, the tasks under protection of nature are fulfilled unaided by the chief forester, as agreed in the forest management plan.

**Landscape protected area**

Areas of protected landscapes stretch over protected areas so that they can include a diversified landscape of varied ecosystems as well as fulfil touristic and recreational needs and play an important role of ecological corridors.

These areas include complete units of natural habitats such as river valleys, hill ranges, forest complexes, bogs and dune fields.

Areas of protected landscapes are established by resolutions of voivodeship regional councils, which regulates prohibitions selected from the catalogue laid down in the Nature Conservation Act.

Nine such prohibitions can be introduced in the area of protected landscape, including *inter alia*: eliminating and destroying trees planted in the fields, watersides or on the side of the roads; extracting stones for economic purposes (such as peat and fossils, remains of plants and animals as well as minerals and amber); conducting works leading to permanent distortion of landscape; introducing changes to existing hydrographic conditions unless they serve purposes other than nature conservation; sustainable use of arable fields and forests; as well as eliminating natural water reservoirs, oxbows and wetlands. It is prohibited to destroy or harm objects of cultural and historical importance at the area of protected landscapes.

All regulations concerning active protection of ecosystems and prohibitions concerning a particular protected area or its part are selected from prohibitions resulting from particular needs and set by voivodeship regional councils.

**Nature protection authorities and institutions**

In accordance with the Nature Protection Act there are the following authorities in the field of nature protection:
- minister responsible for the environment;
- General Director for Environmental Protection;
- Voivodeship governor;
- Regional Director for Environmental Protection;
- marshal of voivodeship;
- national park director;
• governor of the county;
• commune administrator, mayor or city president.

Regional Directorate for Environmental Protection

The tasks of the Regional Director of Environmental Protection, set forth by the *Act of 3 October 2008 on the provision of information on the environment and its protection, public participation in environmental protection and environmental impact assessments*, include:
• participating in strategic environmental impact assessments;
• carrying out impact assessments of projects on the environment or participation in such assessments;
• establishing and closing the forms of nature protection under the *Act on Nature Conservation* of 16 April 2004;
• protection and management of Natura 2000 sites and other valuable natural areas covered by the forms of nature protection under the principles and to the extent determined by the *Act on Nature Conservation*;
• issuing decisions under the *Act on Nature Conservation*;
• carrying out investigations and performing other tasks referred to in the *Act on the prevention of environmental damage and its repair*;
• transmitting data to the database;
• executing tasks related to participation of the organisation in the Community Eco-Management and Audit Scheme (EMAS) under the principles and in the scope defined in the *Act on the national Eco-Management and Audit Scheme* (EMAS);
• cooperating with local government bodies in matters of environmental impact assessments and nature protection.

Legal Governance of Underground Mineworkings

Minerals and mine workings are legally administered in Poland on the basis of the Geological and Mining Law (Act of 9 June 2015, Dz. U. of 2015, No. 196, as amended). Until 31 December 2014 tourist routes of the Krzemionki Archaeological Museum and Reserve were not subject to supervision by the Higher Mining Office. They were not included in closed down underground mines to which, in accordance with Ordinance of the Minister of Environment of 16 December 2011 (Dz. U. No. 286, item 1686), provisions of the Geological and Mining Law apply. Since 1 January 2015, due to the entry into force of a new Geological and Mining Law and Act amending the *Geological and Mining Law* and several other acts of 11 July 2014 (Dz. U. of 2014, item 1133) tourist routes of the Krzemionki Archaeological Museum and Reserve are under jurisdiction of mining supervisory authorities. In accordance with the Act its provisions shall apply to construction, expansion and maintenance of drainage systems of liquidated mining plants as well as the excavation works carried out in closed underground mining plants for purposes other than those specified by law, in particular, in touristic, curative and
recreational purposes or underground works conducted for scientific, research, experimental and training purposes for the needs of geology and mining. The mining supervisory authority exercises supervision and control over the mining plants activities, in particular:

• industrial safety;
• fire safety;
• emergency rescue teams;
• management of mineral deposits in the process of their extraction;
• environmental protection and deposits management, including exercising by the entrepreneurs the obligations determined by separate provisions according to the criterion;
• damage prevention;
• construction and closure of a mining plant, including the land reclamation after the mining activity.

**Protection in Local Law and Spatial Policies**

The issues of spatial planning are regulated by the *Act on spatial planning and area development* (Journal of Laws 2003, No. 80, item 717, as amended). Formulation and conduct of spatial policy in the municipality is its own responsibility. The spatial planning system in the municipality is established by two types of documents:

• study of conditions and directions of spatial development of the municipality (hereinafter referred to as ‘study’);
• local spatial development plan (hereinafter referred to as ‘local development plan’).

The **study of conditions and directions of spatial development** of the municipality is a compulsory document, drawn up for the whole territory of the municipality. It defines the municipal spatial policy and rules of its implementation, taking into account the supra-local planning arrangements binding for the municipality (statutory). The study is an integrated planning document of municipal development, covering spatial issues and the programme of socio-economic development with binding arrangements in terms of the basic elements of spatial development and protection of sites. The study is associated with all the programmes developed by the municipality (especially the ones concerning environmental protection, supply of utilities, transportation, etc.). The study coordinates investment and protection plans of all bodies of public administration, its findings should be binding for all public authorities within the municipality.

The following content, presented in the form of text and graphics, is the subject of the study:

• content related to the existing condition, i.e. the diagnosis of the current socio-economic situation of the municipality and the conditions of its development, recognising objective circumstances of the development;
• content determining the directions of spatial development and the principles of spatial policy, i.e. the basic rules of action in space adopted by local governments.
The study defines, *inter alia*:

- directions of changes in the spatial structure of the municipality and in allocation of land;
- directions and indicators relating to the development and use of land, including the land excluded from construction;
- areas and the principles of protection of the environment and its resources, protection of nature, cultural landscapes and spas;
- areas and principles of protection of cultural heritage and historical and contemporary cultural properties;
- areas that require transformation, rehabilitation or recultivation.

The Study is not an act of local law, but its provisions are binding for the municipal authorities in the preparation of local development plans. It is adopted by a resolution of municipality or commune council.

The *local development plan* is an act of local law and the main tool for implementation of the spatial planning policy in the municipality. The local development plan is adopted by resolution of municipal council. It defines the purpose, conditions of land management and development, and location of public purpose investment. Local development plans are developed for areas identified in the Study and are compulsorily for areas of development extension, as identified in the Study. The plan consists of a text (resolution) and a graphic (attachment to the resolution) parts.

Local development plans are regulations generally applicable in the area, they are the basis for issuing administrative decisions (as opposed to the Study). Their findings, together with other provisions, shape the manner of exercising property rights. Planning power of the municipality is limited by the rights of real estate’s owners or holders of perpetual usufruct.

The local development plan sets out mandatorily:

- allocation of land and demarcation lines for land of different purposes or different management principles;
- the rules for the protection and development of spatial order;
- the rules for the protection of the environment, nature and cultural landscape;
- the rules for the protection of cultural heritage, monuments and treasures of contemporary culture;
- the requirements arising from the needs of the public space formation;
- the principle of forming construction and land development indicators, the maximum and minimum intensity of building as an indicator of the total building surface in relation to the surface of building plot, the minimum percentage of biologically active area with respect to the surface of the building plot, the maximum height of buildings, the minimum number of parking spaces in the space allocated for parking of vehicles equipped with a parking card and the manner of their implementation, and development lines and dimensions of objects;
- boundaries and methods of land management or objects under protection, determined on the basis of separate provisions, including the mining areas, as well as areas of special flood hazard and areas of subsidence and earth masses;
- the detailed terms and conditions of consolidation and division of real estate covered by the local plan;
• the specific conditions of land use and restrictions on its use, including the prohibition of development;
• the principles of modernisation, expansion and construction of communication systems and technical infrastructure;
• the manner and timing of interim management, organisation and use of land.

The local spatial development plans have established the rules concerning the principles of protection of the environment, nature and cultural landscape as well as the boundaries and ways of managing areas protected under separate regulations.

Establishment of spatial development rules is a responsibility of municipality. These tasks are performed in consultation or have to be agreed with the institutions and government authorities as specified in legal provisions, according to their competences. Preparation of planning documents and their adoption for implementation is subject to public consultations procedure.

The Role of Local Authorities in the Heritage Protection System

Both government administration and self-government units of all levels are responsible for the execution of tasks connected with the protection of heritage.

In light of the Act on the commune self-government (Journal of Laws of 2013 position 594, as amended) matters of spatial order, environmental protection and nature, culture and protection of historic monuments and care of monuments are included in the commune’s own tasks. The Act on the district self-government (Journal of Laws of 2013 position 595 and 645 and of 2014 position 379) provides that the district executes tasks concerning communal character and, among others, in environmental and nature protection, culture and of historic monuments and care of monuments. These tasks have a complementary character and concern only those, which cannot be carried out at the level of a commune.

In case of cultural heritage, it should be emphasised that above-mentioned provisions relate to both protection of monuments and care of monuments since self-government units are also owners of a large percentage of immovable monuments and, as such, are obliged to take care of them. Further, the commune is entitled to a pre-emption right in case of the sales of real estate entered in a register of monuments or right of perpetual usufruct of such a real estate. In such case self-government units, jointly with remaining owners, are obliged to take care for entrusted objects.

Significant competence in the execution of heritage protection tasks was handed over to self-government units. By implementing decisions concerning programs of care of monuments (monuments protection strategy), self-government units complement the activities
of the State in the field of legal protection of monuments. Communes have competence in designating cultural parks, keeping municipal inventory of historic monuments and introduce monument protection in local spatial development plans. A very important part of managing the cultural heritage of the area is played by heritage protection strategies, which are developed and implemented at all levels of local government.

In the case of nature conservation, self-government units, apart from pursuing their objectives through relevant provisions in planning documents, have competence in establishing forms of the conservation of nature. Establishing landscape parks and areas of protected landscape is in the competences of the Regional Councils of voivodeships. Whereas monuments of nature, documentary sites, area of ecological use or nature and landscape complexes, are established under the resolution of the commune council.

**Buffer Zones**

Buffer zones have been delineated around each of the four component parts. Their recognition and adoption is crucial due to the status of planning polices in order to protect the cultural, natural, and landscape values of the nominated Property.

**Krzemionki Opatowskie Mining Field**

The buffer zone of the *Krzemionki Opatowskie Mining Field* comprises a forest complex located on the south and west and arable lands on the east and north. The total size of the buffer zone is 1,328 hectares. The northern border coincides with the division of forest compartments (działy leśne), whilst on the remaining sides it is clearly enclosed by the local and voivodeship roads; clearly defined boundaries regarding the general landscape character, views into and out of the component part, and also appropriate for management.

The buffer zone has been determined in such a way as to include the areas most exposed to potential risks, and to protect setting and inter-visibility between the component parts. In the north and west, these are the villages of Sudół and Magonie, suburbs of Ostrowiec Świętokrzyski city where single-family housing is developing. Incorporating these areas into the buffer zone enables to control the housing development in the close vicinity of the nominated Property. Furthermore, whilst the nominated Property is drawn to include sufficient attributes and elements to fully satisfy integrity, the buffer zone extends over an area that also likely contains potential further remains of settlement from the time when the prehistoric mines in Krzemionki were in operation, including, most importantly, mining camps and the place of processing the flint. These areas are in the vicinity of Magonie village, the Sudolska valley, and the left bank of the Kamienna River valley. They are, however, all rather intensively cultivated, which has a direct impact on their state of conservation. Additionally, the buffer zone stretches over the ‘Księża Rola Mała’ prehistoric mine neighbouring with
Krzemionki, situated southeast of the property. Due to agricultural activity, the area will also benefit from a level of added protection and sensitive management.

**Borownia Mining Field**

The buffer zone of *Borownia Mining Field* extends over part of the Kamienna River valley and upland/high plateau located on the right, east bank of the river. The area is important for the protection of setting, and for views and inter-visibility between component parts. It includes both forest complexes and agricultural lands, such as arable fields, meadows and wastelands. The total size of the buffer zone is 120 hectares. Its boundary follows the edge of the Kamienna River valley in the west and on the remaining sides either at the border between forests and fields or at the boundaries of cadastral parcels and forest compartments. Determination of the buffer zone in such a way also enabled the inclusion of the most potentially interesting areas in the proximity of the nominated Property. These are, *inter alia*, the remains of the mining settlements (such as ‘Osiedlisko Przy Zrobach’ settlement) and the river valley itself, which could potentially provide a lot of further information about the Palaeolithic environment from the time when the prehistoric flint mine operated.

**Koryczna Mining Field**

The buffer zone of *Koryczna Mining Field* includes the forest complex located west, north and south of the property as well the area of the quarry with a fragment of the Śródborze village located east and north-east of the nominated component part. The total size of the buffer zone is 134 hectares. The boundaries of the buffer zone follow the forest roads that divide forest compartments and boundaries between forests and arable fields (nowadays usually wastelands). The eastern border however is clearly designated by the local Śródborze-Gliniany road. Defining the borders of the buffer zone in this way can protect the setting whilst also enabling the inclusion of a quarrying site in close proximity to the component part and, as a result, allows control of its activity and the prevention of any potential negative impact on the nominated Property. A broad buffer zone to the west of the component part also affords some additional protection to an area which has archaeological potential connected with prehistoric flint mining (as it was in the case of the ‘Nowa’ mine in 2011).

**Gawroniec Settlement**

The buffer zone of *Gawroniec Settlement* includes the open setting of the Kamienna River in the north (including its distinctive right-angled course where it meets Ćmielów), an important feature in the setting and which has a prehistorical relationship to all component parts as well as aspects of current views and general inter-visibility between component parts. The road forms a logical boundary in the east, whilst in the south and west, the distinctive promontory, an exemplary Neolithic settlement location, is enhanced by the setting of the ‘canyons’ that
border the component part, together with their rising ground to open agriculture. The buffer zone also includes two distinct prehistoric landscapes: a fragment of land on Sandomierska Upland and a 1.5 km-long stretch of the Kamienna River valley. These two areas differ in the way they have been historically used: the Upland area is dominated by agricultural activity whereas in the Kamienna River valley there are dense urban concentrations of houses, industrial plants, railway and numerous wastelands. The total size of the buffer zone is 247 hectares. The boundaries overlap with a natural edge of the Kamienna River valley in the north and north-east. The remaining borders, however, have been designated in most cases to follow local roads. The buffer zone is also designated in such a way to contain the contrasting landscapes of the edge of loess upland – the central urban segment of Ćmielów located at its foot, as well as the flat lowest situated river valley. The buffer zone which extends over both the settlement and a large part of the neighbouring Kamienna River valley further enables:

• added protection for many archaeological sites surrounding the nominated Property (dating back to the period from the Palaeolithic era to the Middle Ages);
• control development within Ćmielów city, to avoid any potential negative impacts on the nominated Property;
• preserve the landscape (castle, city, river valley) through protection of the Kamienna River valley;
• partially protect the settlement ‘axis’ stretching alongside the valley in the northerly direction to Iłżeckie Upland, connecting the Ćmielów settlement with the flint exploitation area.

We realise that a site of such universal cultural value has to demonstrate an appropriate level of protection, accessibility and management at an appropriate level of financing. Therefore, in 2011-2012 we built a complex of buildings and facilities allowing the effective support of increasing numbers of visitors, together with scientific work in the Museum. Within the next two years, we are planning to take further actions to secure appropriate protection of the site and its accessibility, especially for the less-abled.

Zbigniew Duda
Ostrowiec District Governor
5.d Existing Plans Related to Municipality and Region in which the Proposed Property is Located (e.g. Regional or Local Plan, Conservation Plan, Tourism Development Plan)

Studies and Documents Concerning Protection and Management

1. Plan of protective tasks for the Nature 2000 Krzemionki Opatowskie area
Regulation of the Regional Director for Environmental Protection in Kielce of 10 August 2015 on the establishment of a plan of conservation tasks for the Nature 2000 Krzemionki Opatowskie area PLH260024, item 2406, Official Gazette of the Świętokrzyskie Voivodeship, 14 August 2015


The area was designed to preserve in an appropriate manner the following natural habitats and plant species listed in Annexes I and II of the Council Directive 92/43/EEC on the conservation of natural habitats and wild fauna and flora, of May 21, 1992 (Journal of Laws UE-sp.15-2-102 with amendments):

1. Natural habitats:
   • Xerothermic grasslands (*Festuco-Brometea* and thermophilic grasslands *Asplenion septentrionalis Festucion pallentis*)
• Central European and sub-continental deciduous forest (Galio-Carpinetum, Tilio-Carpinetum)
• Thermophilic oak forest (Quercetalia pubescenti petraeae)

2. Protection and Management of the Property

2. Plant species:
• Adenophora liliifolia
• Cypripedium calceolus

The plan assumes a series of activities aimed at preserving the abovementioned natural habitats and plant species.

2. Protection Plan for the Krzemionki Opatowskie Nature Reserve

Regulation No. 32/2009 including annexes, issued by the Regional Director for Environmental Protection in Kielce on October 12, 2009, regarding the establishment of a protection plan for the Krzemionki Opatowskie nature reserve.

The protection of the reserve is aimed at preserving rare and protected plant species as well as the striped flint mines, mining excavations and traces of miners’ workshops and camps. Due to the dominant subject of protection, the reserve has been classified as cultural type (PKu), subtype – monuments (za), but concerning the main type of ecosystem as a type of various ecosystems (EE).

The legal basis for the operation of the reserve is the Regulation of the Regional Director for Environmental Protection on the Krzemionki Opatowskie nature reserve, of 20 September 2017, listed in the Official Gazette of the Świętokrzyskie Voivodeship, item 2911. This regulation was preceded by the Regulation of the Minister for Environmental Protection, Natural Resources and Forestry of June 27, 1995, regarding recognition of Krzemionki Opatowskie as a nature reserve (M. P. No. 33 item 396), which was included in the announcement of the Governor of Świętokrzyskie Voivodeship concerning the publication of a list of reserves, dated October 15, 2001 (Journal of Laws of the Świętokrzyskie Voivodeship, No. 107, item 1270). Pursuant to Article 157 of the Regulation of April 16, 2004 on Nature Conservation (Journal of Laws of 2016, item 2134, as amended), this regulation expired on the date when the new regulation became effective on September 20, 2017. According to Article 153 of this regulation, the nature reserve established before the date of its entry into force has become a nature reserve within the meaning of the new regulation.

The protection plan identifies potential internal and external threats as well as their consequences and specifies ways of their elimination or limitation. Then, protective measures in the field of active protection were determined, specifying their type, scope and location. The protection plan introduces the following determinants for the study of the conditions and directions of spatial development of the municipalities: Bodzechów and Ćmielów, local spatial development plans and the spatial development plan of the Świętokrzyskie Voivodeship regarding the elimination or reduction of external threats:
• in the local spatial development plans of counties, the area of the reserve should be an enclave in which linear projects should not be located, that includes power grids, ski lifts and cableways;
• any projects, and in particular those that can significantly affect the environment, should be localized in a way that guarantees no adverse impact on the reserve;
• any economic activities, including commercial and other endeavours carried out within the area of the reserve and adjacent to the reserve buildings and in the wider area (in the case of further-reaching impacts), should be adapted to the protective, scientific-didactic and tourist function of the entire ‘Krzemionki Opatowskie’ reserve.
In the case of the Krzemionki Opatowskie underground tourist route, the plan imposes an obligation to conduct systematic measurements and tests in order to ensure proper condition of the underground and security of visitors. In particular, the microclimate of the underground must be monitored.

Annex, attachment no. 9

Care Programs Aimed at Protecting Monuments

Voivodeship care program aimed at protecting monuments

Program of care over the monuments of the Świętokrzyskie Province for the years 2013–2016

Resolution No. XXIX/524/13 of the Sejmik (Assembly) of the Świętokrzyskie Voivodeship of March 25, 2013, regarding the adoption of the ‘Program of care over the monuments of the Świętokrzyskie Province for the years 2013–2016’

– the current document in preparation

Among the main goals, protection and preservation of the heritage and cultural landscape are conducted by, among other activities, identifying and documenting resources, protecting archaeological sites and creating appropriate conditions for the creation and development of cultural parks and the protection of the cultural landscape.

Districts’ programs of care over the monuments

The District Program of Care over the Ostrowiec District’s Monuments for the years 2017–2020

Resolution XL/237/2017 of the Ostrowiec District Council of 30 March 2017

The District Program of Care over the Ostrowiec District’s Monuments has been drawn up on the basis of art. 87 of the Act of 23 July 2003 on the protection of monuments and care over the monuments (Journal of Laws of 2014, item 1446, as amended). It is a continuation of the District Program of Care over the Monuments of the Ostrowiec District for the years 2010–2014, which was adopted by the Ostrowiec District Council Resolution No. XLVII9/310/10 of June 25, 2010. The District Program of Care over the Ostrowiec District’s Monuments has been prepared while taking into account the external conditions affecting the protection of cultural heritage, including legal acts and other strategic studies on similar topics at the national and provincial levels. Based on the analysis of the conditions, three main priorities have been defined, followed by directions of activities and tasks aimed at proper care of the district’s monuments. Selected exemplary tasks defined in the program of care over the monuments:

Priority I – Protection, preservation and shaping of the cultural landscape
Directions of activities: Stopping the monuments degradation process and improving their state of preservation
The tasks include:
• Consistent implementation of program documents’ content in relation to monuments and the cultural landscape of the district.
• Protection of the most valuable archaeological sites – support for municipalities.
• Checking the conservation status of the most valuable archaeological sites and taking measures to exclude the immediate environment from active agricultural pursuits.
• Stocktaking and documentation of mining fields and including them in the protected zone – cooperation with WKZ (Wojewódzki Konserwator Zabytków – Voivodeship Conservator of Monuments).
• Taking into account archaeological sites in forest arrangement projects.

Priority II – Heritage research and documentation
Direction of activities: Specialized research recognition of individual objects, complexes and historical areas related to an investment process under preparation or implementation.
The tasks include:
• Cooperation with municipalities and the voivodeship conservator of monuments in the field of verification of the municipality records of monuments.
• Cooperation with local associations dealing with the issues of history and cultural heritage.

Priority III – Promotion and education in the field of cultural heritage
Direction of activities: Increasing cultural awareness of the local community by its participation through various forms of activity
The tasks include:
• Creating the image of the municipality, based on the resources of cultural heritage and the local identity of the inhabitants.
• Dissemination of education on the protection of cultural heritage in educational and other pedagogic institutions.

Direction of activities: Tourist promotion of the region
The tasks include:
• Supporting efforts to have the Krzemionki Reserve – a complex of mines, inscribed on the UNESCO World Heritage List.

Annex, attachment no. 10

Municipal Programs of Care over the Monuments

The Municipal Program of Care over the Monuments of the Bodzechów Municipality for the years 2010–2014

The Municipal Program of Care over the Monuments of the Municipality and Town of Ćmielów for the years 2010–2013
Resolution No. XLV/342/2010 of the Ćmielów Municipal Council, June 10, 2010
Spatial Planning

Spatial development plan for the Świętokrzyskie Voivodeship
Resolution No. XLVII/833/14 of the Sejmik (Assembly) of the Świętokrzyskie Voivodeship of September 22, 2014, regarding the adoption of an amendment to the Spatial Development Plan of the Świętokrzyskie Voivodeship, hereinafter referred to as the Spatial Development Plan of the Świętokrzyskie Voivodeship.

The spatial development plan for the Świętokrzyskie Voivodeship, while defining the long-term goals and directions of the Voivodeship spatial policy, simultaneously presents the spatial development ideas for the Świętokrzyskie region for the next 25–30 years. In the part concerning the conditions, the plan indicates the importance of cultural heritage, also for the promotion and tourism activation of the Voivodeship. Among the spaces that can play a particularly important role, the plan draws attention to the most valuable areas and monument complexes as well as the unique objects on a European or global scale, including the vast area of the Old-Poland Industrial District saturated with monuments from the seventeenth-nineteenth centuries, and among them the area of the Kamienna (Stone) River Valley with the Monument of History ‘Krzemionki – flint mines from the Neolithic era’, an object nominated for inclusion in the UNESCO World Heritage List.

The preservation and protection of objects and complexes of the highest rank and special importance for national culture and world heritage were considered as priority activities. Indicating the goals and directions of spatial policy, the Voivodeship’s plan considers protection and rational use of cultural and natural heritage resources as some of the most important, including creating conditions to protect valuable natural, cultural and landscape components and creating favourable climate for the organization of cultural parks in areas with a distinct cultural landscape, among others the area of the Kamienna River valley, within whose borders the place proposed for inclusion in the World Heritage List is located.

Study of conditions and directions of spatial development of the Bodzechów Municipality
– in the process of preparation

Study of conditions and directions of spatial development of the Ćmielów Municipality
Resolution No. XXIV/203/2013 of the Ćmielów Municipal Council of January 24, 2013

The study of the conditions and directions of spatial development for the area of the town and the municipality of Ćmielów takes into account the principles set out in the concept of spatial development of the country, establishing the development strategy and spatial development plan of the Voivodeship and the development strategy of the municipality. The directions of development result to a large extent from the Spatial Development Plan of the Świętokrzyskie Voivodeship and the Development Strategy of the Town and the Municipality of Ćmielów. In the case of archaeological sites subject to legal protection, the Study allows investment activity under the condition of obtaining a written permit from the Conservator
of Voivodeship’s Monuments. Such activities must be carried out under the supervision of an appropriate conservator of monuments. The Study also allows agricultural development on archaeological sites, although special care is needed as archaeological monuments may be threatened by too deep ploughing. At the same time, the Study allows exclusion of archaeological sites from the location of an investment, according to the scientific and conservation considerations.

**Study of conditions and directions of spatial development of the Ożarów Municipality**

Resolution No. XXXV/259/2013 of the Ożarów Municipal Council of October 22, 2013, regarding the adoption of a Study of conditions and directions for spatial development of the Ożarów Municipality for the area within the administrative boundaries of the municipality.

The objectives of the spatial policy of the Ożarów municipality were determined on the basis of the conditions for the development of the town and the municipality of Ożarów specified in the first part of the study, and while taking into account their impact on setting directions, as well as that included in the ‘Strategy for the development of the town and the municipality of Ożarów until 2020’ (2004) strategic objective of ensuring the best living environment for residents and favourable conditions for the functioning of business entities, while respecting the principle of sustainable development. Among them was mentioned the use of the municipality development opportunities resulting from high natural and landscape values and the presence of valuable cultural heritage complexes and objects, including archaeological sites that have a field exhibition, including unique archaeological monuments (e.g. flint mines). The study assumes that for archaeological objects entered in the register of monuments, the spatial policy includes a ban on any interference in the area occupied by archaeological sites. For archaeological monuments entered into the register of monuments, the Study marks the archaeological monuments protection zones – ‘W’, in which the following applies:

- prohibition of any building developments,
- prohibition of any engineering, construction and other activities related to earthworks (such as digging wells, drainage, grubbing and planting trees, etc.), apart from archaeological research and works aimed at protecting the monument from destruction, carried out under the rules laid down in separate provisions on the protection of monuments,
- preservation of the existing topographical layout of the area.

**Revitalisation Programs**

**Bodzechów Municipality Revitalization Program for the years 2016–2023**

Resolution No. XXXIV 93 2016 on the adoption of ‘Bodzechów Municipality Revitalization Program for the years 2016–2023’

The revitalization program of the Bodzechów municipality assumes, among others, improved access to public services and improvement of their quality (educational, health, cultural
services, etc.) through upgrading the infrastructure of the Historical and Archaeological Museum and the Krzemionki Reserve (budget: PLN 5 million for 2017–2019, including funds obtained from EU programs).

The program is in the process of implementation. The Historical and Archaeological Museum in Ostrowiec Świętokrzyski received a subsidy from the Infrastructure and Environment 2014–2010 Operational Program under the 8th priority axis – ‘Protection of cultural heritage and development of cultural resources’ – for the implementation of the project ‘Increasing the accessibility of the Historical and Archaeological Museum in Ostrowiec Świętokrzyski through improving the infrastructure of the Archaeological Museum and the Krzemionki Reserve as well as of the Palace of Wielopolski Family’. The aim of the project is to increase the accessibility of the Historical and Archaeological Museum in Ostrowiec Świętokrzyski through a fundamental improvement of infrastructure in both branches of the Museum, and as a consequence improving the cultural and tourist offer regarding the values of the natural environment and the cultural heritage potential of the Świętokrzyskie Voivodeship.

In Krzemionki, the project envisages the implementation of activities including the modernization of tourist infrastructure facilities, including:

• reconstruction of two buildings over the shafts,
• construction of lifts for the disabled,
• reconstruction of underground lighting of the tourist route,
• video monitoring of the historic mining excavations,
• adaptation of the object for the needs of people with speech, hearing and visual impairments,
• installing a permanent exhibition in the museum building.

For the residents and authorities of Bodzechów commune, having a cultural heritage of world value on their premises is a source of pride and a commitment to take care of it. This is reflected in the strategic documents related to the development of the commune and ongoing cooperation with the museum, which manages the area of the prehistoric flint mine in Krzemionki.

Jerzy Murzyn
Wójt Gminy Bodzechów
Owners and administrators are obliged to take care of the heritage under the laws currently in force in Poland. The role of the State is the designation of areas for which their preservation is in the public interest (through the introduction of various forms of legal protection) and to ensure adequate conditions that enable owners and administrators to exercise care, *inter alia*, by establishing rules, ensuring professional assistance (conservation services, institutes and research centres), and launching programmes providing financial support for the actions aimed to protect and promote the heritage. The system of legal protection of heritage in Poland does not provide for special forms of protection of World Heritage Sites and candidates applying for inclusion in the List, and it does not require their specific organisation. It is deemed appropriate to adapt the existing forms and measures designed to protect the individual nature of a World Heritage Site and requirements for the implementation of the World Heritage Convention.

### Cooperation Aimed at the Implementation of the World Heritage Convention at the National Level

The Ministry of Culture and National Heritage is in charge of the protection of the cultural heritage and implementation of the World Heritage Convention in this respect. In order to streamline the actions and increase their effectiveness in 2007 the Minister of Culture and National Heritage established the World Cultural Heritage Committee in Poland, an authority assisting the Minister whose responsibilities include ‘preparing opinions, applications, analyses and expert reports and taking other measures related to the implementation of the provisions of the Convention’.

At the same time, the Minister designated the National Heritage Board of Poland (NID) from among the subordinate institutions as an entity in charge of the coordination of matters related to the implementation of the World Heritage Convention and cooperation with the World Heritage Sites, including the assistance in the preparation of candidates for inclusion in the World Heritage List. With this in mind, the National Focal Point (Ośrodek do spraw Światowego Dziedzictwa) in 2014 was established at the National Heritage Board to formalize and strengthen the function of a focal point which the National Heritage Board served in the context of implementation of the World Heritage Convention. It takes advantage both
of the Board's specialists dealing with a wide range of matters related to the cataloguing, documentation, protection, conservation and presentation (education) of the heritage, and of expert organisations and individuals specialising in the protection and conservation of the heritage.

The diagram shows the principles of cooperation between the institutions operating at the national level which are directly responsible for the implementation of the World Heritage Convention.

**General national scheme for implementation of the protection, conservation, presentation and management of World Cultural Heritage Sites**

![Diagram](image)

**System for Managing the Nominated World Heritage Properties**

Point 5.a includes the description of the ownership structure and entities managing buildings and sites located within the boundaries of the nominated World Heritage Property. Specific units exercise care for specific components of a World Heritage Property within the area of their competences and in line with the rules in force. The list of partners in managing and the main stakeholders in the protection, conservation and presentation of the nominated Property is presented on the next page.
## Owners and administrators of the nominated Property

<table>
<thead>
<tr>
<th>Institution</th>
<th>Address</th>
<th>Contact person</th>
<th>Contact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ośrodek ds. Światowego Dziedzictwa w Narodowym Instytucie Dziedzictwa [Centre for World Heritage at the National Heritage Board of Poland]</td>
<td>ul. Kopernika 36/40 00-924 Warszawa <a href="http://www.nid.pl">www.nid.pl</a>; <a href="http://www.swiatowedziedzictwo.nid.pl">www.swiatowedziedzictwo.nid.pl</a></td>
<td>Katarzyna Piotrowska Kierownik [Head of Department]</td>
<td><a href="mailto:kpiotrowska@nid.pl">kpiotrowska@nid.pl</a>; <a href="mailto:unesco@nid.pl">unesco@nid.pl</a>; <a href="mailto:info@nid.pl">info@nid.pl</a></td>
</tr>
<tr>
<td></td>
<td>25-516 Kielce al. IX Wieków Kielc 16/13</td>
<td>Włodzimierz Pedrycz Kierownik [Head]</td>
<td><a href="mailto:ot.kielce@nid.pl">ot.kielce@nid.pl</a>; <a href="mailto:wpedrycz@nid.pl">wpedrycz@nid.pl</a></td>
</tr>
<tr>
<td></td>
<td>Sudół 135 a 27-400 Ostrowiec Świętokrzyski <a href="http://www.muzeumostrowiec.pl">www.muzeumostrowiec.pl</a></td>
<td>Włodzimierz Szcząłuba Dyrektor [Director]</td>
<td><a href="mailto:dyrektor@muzeumostrowiec.pl">dyrektor@muzeumostrowiec.pl</a></td>
</tr>
<tr>
<td></td>
<td>Świętokrzyski Urząd Wojewódzki Zabytków w Kielcach [Provincial Heritage Monuments Protection Office in Kielce]</td>
<td>Anna Żak-Stobiecka Świętokrzyski Wojewódzki Konserwator Zabytków w Kielcach [Świętokrzyskie Provincial Conservation Officer in Kielce]</td>
<td><a href="mailto:sekretariat@wuozielce.pl">sekretariat@wuozielce.pl</a></td>
</tr>
<tr>
<td>Institution</td>
<td>Address</td>
<td>Contact person</td>
<td>Contact</td>
</tr>
<tr>
<td>-------------</td>
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<td>----------------</td>
<td>---------</td>
</tr>
<tr>
<td>Municipality and the Communal office of Ćmielów</td>
<td>ul. Ostrowiecka 40 27-440 Ćmielów <a href="http://www.ugb.pl">http://www.ugb.pl</a></td>
<td>Jan Kuśmierz Burmistrz [Mayor]</td>
<td><a href="mailto:urzad@cmielow.pl">urzad@cmielow.pl</a></td>
</tr>
<tr>
<td>Commune Office of Bodzechów</td>
<td>ul. Reja 10 27-400 Ostrowiec Świętokrzyski <a href="http://www.ugb.pl">http://www.ugb.pl</a></td>
<td>Jerzy Murzyn Wójt [Commune Head]</td>
<td><a href="mailto:urzad@ugb.pl">urzad@ugb.pl</a></td>
</tr>
<tr>
<td>Municipality and the Communal office of Ożarów</td>
<td>ul. Stodolna 1 27-530 Ożarów</td>
<td>Marcin Majcher Burmistrz [Mayor]</td>
<td><a href="mailto:urzad.mig@ozarow.pl">urzad.mig@ozarow.pl</a></td>
</tr>
</tbody>
</table>
The work on the preparation of the candidacy and application for inclusion in the World Heritage List resulted in the development of an informal framework of cooperation which will be confirmed by the decisions of competent institutions at the right time. ‘Krzemionki’ Archaeological Museum and Reserve acts as the coordinator of the actions aimed to preserve and promote the nominated Property.

As part of the nomination process, a review of the wider prehistoric landscape associated with Krzemionki prehistoric striped flint mining region was undertaken, and its results used to inform sections 2b and 3.2. As a consequence of this exercise, from which the nominated component parts were selected, the collective importance of numerous other prehistoric settlement sites and smaller flint mines (of various types, including minor striped flint) was highlighted. A concept that is currently (2018) being considered is that of a Krzemionki prehistoric striped flint mining region – and its wider setting – will benefit from added protection in the form of a formally designated cultural park.

Cultural parks are created under the Act on the protection of monuments and the guardianship of monuments (Act of 23 July 2003, Journal of Laws of 2003, No. 162, item 1568, as amended) in order to protect the cultural landscape and preserve some outstanding landscape areas with immovable monuments characteristic of the local tradition of building and settlement. The decision to set up a cultural park is taken by the municipal council (or councils in case when the area of the park covers more than one administrative unite), after consulting the Voivodeship Monument Conservator competent for this territory. A local spatial development plan is prepared obligatorily for the cultural park. A management plan also has to be also prepared, and the protected area management unit may be appointed. Prohibitions and restrictions may be established in the cultural park or its part concerning:

- carrying out construction works and industrial, agriculture, culture, trade or service activities;
- changes in the use of immovable monuments;
- placing of boards, inscriptions, advertising and other signs not related to security of the cultural park, with the exception of road signs and signs related to the protection of public order and safety (with reservations);
- waste disposal or storage.

Along with the work on the designation of culture park a comprehensive management plan for the Krzemionki prehistoric striped flint mining region and its setting will be developed. It is scheduled to be completed by the end of 2018.

The essential protection measures are divided into two groups of conservation measures: active and passive. Active protection means taking immediate measures aimed at reducing or eliminating completely most of the threats, as well as comprehensive documentation developed as a basis for taking further steps, including regulation of legal status of sites in question, as well as development of local development plans. Passive measures will aim at popularisation and promotional activities reaching local communities and the wider public.
5.f Sources and Levels of Finance

Currently, the primary sources of funding for administration, maintenance and conservation of the property is from ticket receipts, Local, Regional and National funds, external EU grants.

Annual receipts of the ‘Krzemionki’ Archaeological Museum and Reserve [in PLN]

<table>
<thead>
<tr>
<th>Year</th>
<th>Receipts from ticket sales [PLN]</th>
<th>Receipts from other earned sources [PLN]</th>
<th>Receipts from regional and national sources [PLN]</th>
<th>External grants [PLN]</th>
</tr>
</thead>
<tbody>
<tr>
<td>2017 mthI-VI</td>
<td>206 701</td>
<td>42 391</td>
<td>1 362 976</td>
<td>0</td>
</tr>
<tr>
<td>2016</td>
<td>483 858</td>
<td>22 880</td>
<td>1 260 000</td>
<td>0</td>
</tr>
<tr>
<td>2015</td>
<td>401 102</td>
<td>18 642</td>
<td>1 042 523</td>
<td>71 491</td>
</tr>
<tr>
<td>2014</td>
<td>463 915</td>
<td>9 907</td>
<td>1 159 584</td>
<td>130 000</td>
</tr>
<tr>
<td>2013</td>
<td>466 847</td>
<td>15 715</td>
<td>938 903</td>
<td>0</td>
</tr>
</tbody>
</table>

Total operating costs of the ‘Krzemionki’ Archaeological Museum and Reserve and expenditures for renovation, repair and maintenance of equipment of visitor routes and facilities

<table>
<thead>
<tr>
<th>Year</th>
<th>Total costs [PLN]</th>
<th>Expenditures for staff wages</th>
<th>Expenditures for renovation, repair and maintenance [PLN]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>from own resources</td>
<td>from external grants</td>
<td></td>
</tr>
<tr>
<td>2017</td>
<td>1 386 397</td>
<td>635 229</td>
<td>1 386 397</td>
</tr>
<tr>
<td>2016</td>
<td>1 814 385</td>
<td>1 203 187</td>
<td>1 814 385</td>
</tr>
<tr>
<td>2015</td>
<td>1 499 151</td>
<td>1 048 436</td>
<td>1 427 660</td>
</tr>
<tr>
<td>2014</td>
<td>1 761 216</td>
<td>1 067 568</td>
<td>1 631 216</td>
</tr>
<tr>
<td>2013</td>
<td>1 422 228</td>
<td>927 214</td>
<td>1 422 228</td>
</tr>
</tbody>
</table>

Potential sources of funding for the nominated property are EU funds under the regional programs, funds of the Voivodeship Office of the Protection of Monuments, funds of the National and Voivodeship Fund for Environmental Protection, and private donors.
5.g Sources of Expertise and Training in Conservation and Management Techniques

In terms of knowledge and engineering skills, the background facilities are provided by the scientific environment of Kraków, with the specialized institution of higher education with a long tradition of mining and great achievements. The scientific staff of the University of Science and Technology (AGH) in Kraków is regularly engaged in the research and implementation of technical solutions in the mine. The Faculty of Mining and Geoengineering of AGH has a team dealing with the protection of historic buildings in terms of mining and building. The research work deals with issues such as:

• Protection of historic underground workings of visitor and museum character and strengthening the surrounding rock mass;
• Adaptation of underground mining routes;
• Restoration and reconstruction of existing historic underground workings.

Old historic mines have a special place in research activities at AGH. Academic institutions such as the Silesian University of Technology and Wrocław University of Technology also are the background facilities in this area. The State Mining Authority is an important source of expertise.

In terms of the conservation doctrine and management of historic complexes with the highest value, research facilities for mine staff are provided by the National Heritage Institute and the University of Nicolaus Copernicus (Faculty of Fine Arts, Conservation and restoration of works of art).

Staff hold various professional qualifications and possess various specialist areas of knowledge and experience, including experts in archaeology and conservation of prehistoric flint mines.
5.h Visitor Facilities and Infrastructure

Principal visitor facilities are provided at component part number 1, only (Krzemionki Opatowskie Mining Field). These comprise: underground visitor route, surface trails and interpretive points, and the relatively new (2012) ‘Krzemionki’ Archaeological Museum and Reserve. There are, currently, no visitor facilities at the other three component parts, and no formal public access, but guided tours are under consideration (2017).

Underground Visitor Route

The underground visitor route is 465 metres long and 11.5 metres deep (at its deepest point). The route creates safe viewing access to a range of typical Neolithic mining features underground.

Figure 180. Plan of visitor route.
source: http://krzemionki.pl/o-krzemionkach/trasa-turystyczną/
Figure 181. Krzemionki Opatowskie Mining Field. Plan of chamber mines in the area of shafts 1, 2 and 3 as seen on the visitor route. Key: 1 – original walls and pillars, 2 – Neolithic rubble, 3 – contemporary safety measures, 4 – course of the deepened visitor route, 5 – interpretation of miner working, 6 – Neolithic graffiti (after Bąbel, 1990, revised 2015).

The route is accessed by a spiral steel staircase fitted into an excavated prehistoric shaft.

Figure 182. Shaft pavilions (left) and visitor stairway (right) (author K. Pęczalski).
A level-surfaced tunnel has been excavated in limestone and passes through the natural flint seam to give an excellent insight into the geology and mode of occurrence of striped flint.

**Figure 183 and 184.** Flattened nodules of striped flint exposed in the visitor tunnel cut in hard monolithic limestone (author K. Pęczalski).
The visitor route soon opens into areas of backfilled prehistoric chambers with viewing into pillar-chamber and chamber mines, galleries and other features.

Figure 185 and 186. top – Level visitor route cut below original chamber-floor level to allow safe viewing into the preserved prehistoric mining environment. Bottom – Original prehistoric communication gallery as seen from the visitor route (author K. Pęczalski).
The following prehistoric mining features are accessed along the route:

- Chamber mine 7/610, viewed through special inspection windows.
- Shafts 2, 3, 610, 612, 615, 616, 790, 795, 804, 805, 806, 815, 818 and 821, together with their numerous pillar-chambers and chambers, galleries, back-filled areas, torch marks and graffiti.
- Area of prehistoric chamber mines damaged by limestone quarrying in the 1920s (now called the Great Chambers).
Surface Trails

Surface trails take visitors into the mining field (guided) or self-guided into the nature reserve and the interpretive reconstruction of a Neolithic village.

Figures 188 and 189. The boardwalk that leads visitors over the mining field in the vicinity of pillar-chamber mines. Views into the forest on both sides reveal characteristic prehistoric anthropogenic topography of shaft hollows and tips. Access has been created that guides visitors but restricts free-flow to maintain the state of conservation (author K. Pęczalski – left and B. Gamble – right).

Figure 190. Main trail which leads from the Museum into the mining field (author K. Pęczalski).

Figures 191. Interpretive reconstruction inside the prehistoric village (author D. Zarzycka).

Figure 192 and 193. Interpretive reconstruction in a niche-gallery mine (author K. Pęczalski).
Other Tourist Trails

I. Hiking trails of the Polish Tourist and Sightseeing Society (Polskie Towarzystwo Turystyczno-Krajoznawcze – PTTK)

1. Blue trail: Święty Krzyż – Nowa Słupia – Grzegorzowice – Kałków – Nietulisko – Krzemionki – Bałtów – Pętkowice; 80 km. Included in the network of nationwide PTTK trails, created by one of the oldest tourist organisations in Europe – a merger in 1950 between the Polish Tatra Society (founded 1873) and the Polish Sightseeing Society (founded 1906). PTTK currently has 61,000 members and over 260 branches, accommodation facilities comprising over 20,000 beds.

II. Bike trails

1. Black trail ‘Defence Architecture’ Końskie – Kielce: runs through Ćmielów (‘Gawroniec’), Podgródzie and Borownia; 510 km. The organizer is the Regional Tourist Organization of Świętokrzyskie Province (Regionalna Organizacja Turystyczna Województwa Świętokrzyskiego – ROT WŚ); trail of a regional scale.

2. Witold Gombrowicz green trail: 164 km loop in Świętokrzyskie Province; runs through Ćmielów (‘Gawroniec’). The organizer is the Regional Tourist Organization of Świętokrzyskie Province (ROT WŚ); trail of a regional scale.


4. Yellow trail: loop around Ostrowiec Świętokrzyski running through Krzemionki. The organizer is PTTK St. Jeżewski Świętokrzyskie Branch in Ostrowiec Świętokrzyski; trail of a regional scale.

III. Car trails

1. ‘Świętokrzyskie Literary Trail’: covers the area of the whole Świętokrzyskie province, runs through Ćmielów (‘Gawroniec’) and Bodzechów; associations with Witold Gombrowicz (‘the land of childhood’). The organizer is the Regional Tourist Organization of Świętokrzyskie Province (ROT WŚ); trail of a regional scale.

2. ‘Świętokrzyskie Archaeological-Geological Trail’: Chęciny – Kielce – Zagnańsk – Krzemionki – Bałtów; A car trail with tagged pedestrian access routes to places inaccessible to cars. The organizer is the Regional Tourist Organization of Świętokrzyskie Province (ROT WŚ); trail of a regional scale.
The Museum of Archaeology and History in Ostrowiec Świętokrzyski is a member of the Association of Underground Tourism Trails in Poland. We are linked by a shared tourist offer, publications, including a guide and folder ‘Underground Tourist Trails in Poland’, joint representation at tourist fairs (http://podziemia.pl/trasy/kopalnie/muzeum-archeologiczne-i-rezerwat-krzemionki-w-ostrowcu-swietokrzyskim/).

Krzemionki Archaeological Museum and Reserve, Division of Historical and Archaeological Museum in Ostrowiec Świętokrzyski

The Museum is sited outside the component part so that it avoids any conflict with protection and conservation of the property. Its design is very forward-looking and exceeds anticipated capacity to meet any foreseeable increase in visitor numbers. The visitor centre part provides guided underground and surface tours (available for a fee) of the component part, and supplements such visits with a museum and exhibitions, conference facilities, and even accommodation for visiting scholars.

Figure 194. The new museum and visitor centre complex was constructed outside Krzemionki Opatowskie Reserve in 2012 (author A. Łada).
5. Protection and management of the property

Figure 195. The new museum and visitor centre complex showing offices with accommodation above (left) and conference hall (right), with main entrance in between (author B. Gamble).

Figures 196 and 197. Tourist information centre (left) and high-capacity car and coach parking (right) (author B. Gamble).

Figures 198 and 199. Interpretive panel (left) and entrance to temporary exhibition gallery (right) (author B. Gamble).
5. Protection and Management of the Property

Figure 200. Main museum gallery (author B. Gamble).

Figure 201. Museum exhibit of local prehistoric axes (author B. Gamble).

Figure 202. Digital interactive educational provision in the Museum galleries (author B. Gamble).
5.i Policies and Programmes

Related to the Presentation and Promotion of the Property

The main on-site programme related to the presentation and promotion of the property is split into two: one for general visitors and one for school groups.

The underground tours and surface tours, described above, have different guided options depending on age and specific interests and are always opted for. They access conservation controlled environments (‘museum’ property) but, in addition, a robust interpretive resource is also offered: activities within a reconstruction of a primeval settlement created adjacent to the component part in 1991. This facility was constructed as a result of the joint cooperation between the Historical-Archaeological Museum in Ostrowiec Swietokrzyski and the National Archaeological Museum in Warsaw. The main objective was not to recreate any known archaeological site but to present different aspects of everyday life in the Neolithic and Bronze Age. Therefore, one can find both reconstructions of houses from the Funnel Beaker culture and the Globular Amphora culture, dating back to the 4th and 3rd millennium BCE, as well as from the Mierzanowice culture from the early Bronze Age (the three principal communities associated with Krzemionki striped flint mining). A palisade, moat and megalithic grave complete the reconstruction where museum classes and archaeological workshops are held.

Figure 203. Reconstruction of a megalithic tomb, Krzemionki Opatowskie Reserve (author K. Pęczalski).
Figure 204. ‘Living history’ enactments in the primeval settlement, where everyday life in the Neolithic and Bronze Age is interpreted at regular special events (author B. Gamble).

Figure 205. Reconstruction in one of the Museum exhibition galleries (author B. Gamble).
5.j Staffing Levels and Expertise (Professional, Technical, Maintenance)

The nominated Property is administered by 'Krzemionki' Archaeological Museum and Reserve, located in the Museum premises adjacent to Krzemionki Opatowskie Mining Field. An appropriate level of qualified staffing is maintained and consists of a professional Director who is responsible to a Council of the Museum (8 persons). The Director (Wlodzimierz Szczaluba) has a staff compliment of 25, which increases by two additional seasonal guides to 27 in the summer season. The Museum Curator (Professor Jacek Lech, The Institute of Archaeology and Ethnology of the Polish Academy of Sciences, Autonomous Unit for Prehistoric Flint Mining) provides conservation expertise and directs a specialist staff of two archaeologists, and an ecologist with experience in natural disciplines, especially biodiversity.

Figure 206. The Museum is well-resourced in terms of professional management, scientific and technical staff, as well as visitor management with educational expertise (author B. Gamble).
6. Monitoring
6.a. Key Indicators for Measuring State of Conservation

As the Management Plan being finalised in 2018, indicators will be developed to monitor progress and change (positive and negative) of the state of conservation of the whole nominated property over time. Such information, will be kept by Krzemionki Archaeological Museum and Reserve, division of Muzeum Historyczno-Archeologiczne in Ostrowiec Świętokrzyski, Sudół 135a, 27-400 Ostrowiec Świętokrzyski.

This information will serve as the basis within the national protective framework of Periodic Reporting provided to UNESCO by the National Heritage Board of Poland in six year cycles. These indicators will relate to the tangible attributes of potential Outstanding Universal Value and the physical elements that manifest these. The principal requirement is to ensure that Outstanding Universal Value is successfully sustained and that other values of the property are also maintained over time.

Monitoring will be ongoing and responsive in order to measure, record and report the impact of change – whether positive, neutral or negative. Key indicators are used to assess the state of conservation, the factors affecting it, and the effect of conservation measures, including management strategy.

Monitoring Process

Monitoring will be devised and coordinated by qualified staff of the Krzemionki Archaeological Museum and Reserve, adjacent to the largest component part (Krzemionki Opatowskie Mining Field), who have been conducting daily inspections of the underground visitor route, and of the surface at Krzemionki for many years.

Figure 207. Krzemionki Opatowskie Mining Field. 3D scan showing detail of chamber in limestone, including unconsolidated prehistoric backfill. Such detailed scanning is available for all underground areas (tourist route and shaft 4/606) (author GeoCartis).
The following table illustrates tentative current themes being developed as part of the management planning process in 2018:

<table>
<thead>
<tr>
<th>Theme</th>
<th>Indicator</th>
<th>Method of measurement</th>
<th>Target status</th>
<th>Trend/analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protection</td>
<td>Spatial planning</td>
<td>Existence of WHS policy</td>
<td>Review Strategies and Plans, and any new documents</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Checking effectiveness of policies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Planning guidance</td>
<td>Existence of adopted 5-yearly Property</td>
<td>Permanent meters, Photos, gauges</td>
<td>2018, and every 5 years</td>
<td></td>
</tr>
<tr>
<td>Designations</td>
<td>Management Plan</td>
<td>Every 6-year review of key elements of the Property</td>
<td>2018, and every 6 years</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>under appropriate legal protection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coordination between protection</td>
<td>Checking effectiveness of the nature-culture</td>
<td>Review Strategies and Plans, and any new documents</td>
<td>2018, and every 6 years</td>
<td></td>
</tr>
<tr>
<td>of nature and culture assets</td>
<td>protection</td>
<td>every 6-year review of policies and relevant management</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Condition</td>
<td>Inventory of elements / condition</td>
<td>3D scanning and fixed point photography wherever necessary</td>
<td>Every 5 years</td>
<td></td>
</tr>
<tr>
<td>Safety</td>
<td>Radon level</td>
<td>Permanent meters</td>
<td>Daily</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Structural stability</td>
<td>Photos, gauges</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Humidity</td>
<td>Meter</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Development pressure</td>
<td>Number of planning applications in component</td>
<td>Review</td>
<td>Ongoing</td>
<td></td>
</tr>
<tr>
<td>pressure</td>
<td>parts and buffer zones</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Change</td>
<td>Physical changes within WHS</td>
<td>Short report, supported by photography and assessment</td>
<td>Every year</td>
<td></td>
</tr>
<tr>
<td>Setting</td>
<td>Quality within and outside WHS</td>
<td>Fixed point photography of strategic views and features</td>
<td>Every 5 years</td>
<td></td>
</tr>
<tr>
<td>Theme</td>
<td>Indicator</td>
<td>Method of measurement</td>
<td>Target status</td>
<td>Trend/analysis</td>
</tr>
<tr>
<td>------------------------</td>
<td>-------------------------------</td>
<td>------------------------------------------------------------</td>
<td>------------------------</td>
<td>----------------</td>
</tr>
<tr>
<td><strong>Visitors</strong></td>
<td>Number of visitors</td>
<td>Underground / other Educational Domestic/foreign</td>
<td>Every year</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Yearly spread</td>
<td>Monthly count</td>
<td>Ongoing</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Impact on local community, hotels</td>
<td>Feedback from local authorities and business community</td>
<td>Every 5 years</td>
<td></td>
</tr>
<tr>
<td><strong>Access and Interpretation</strong></td>
<td>Provision</td>
<td>Fixed interpretation Access for less-abled Virtual access / website Foreign language provision</td>
<td>Audit 2018, and every 5 years thereafter.</td>
<td></td>
</tr>
<tr>
<td><strong>WHS awareness</strong></td>
<td>Interpreting WH values</td>
<td>Visitor survey Website hits Media coverage</td>
<td>Every 5 years</td>
<td></td>
</tr>
<tr>
<td><strong>WHS Management</strong></td>
<td>WHS Management Plan</td>
<td>In place Y/N</td>
<td>2018 and every 5 years</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dedicated WHS officer</td>
<td>In place Y/N</td>
<td>2018, ongoing</td>
<td></td>
</tr>
<tr>
<td><strong>Risks</strong></td>
<td>Risk assessment and plan</td>
<td>In place Y/N</td>
<td>2018, ongoing</td>
<td></td>
</tr>
</tbody>
</table>
6.b Administrative Arrangements for Monitoring Property

Monitoring of Krzemionki Opatowskie Mining Field (component part number 1; underground and surface, cultural elements) is conducted by Krzemionki Archaeological Museum and Reserve, Muzeum Historyczno-Archeologiczne in Ostrowiec Świętokrzyski, under the auspices of the Director.

In addition to daily monitoring by archaeologists, there is also regular specialist monitoring of structural stability underground by external mining and geological specialists. In 2016–2017, 3D laser scanning was conducted for the underground areas (tourist route and shaft 4/606), a useful tool for detailed recording of state of conservation.

The Nature Reserve area is supervised by museum staff, which also conducts monitoring of the conservation status of the historic mining field. Specialist monitoring of part of the nature reserve ‘Krzemionki Opatowskie’ is also undertaken on an ongoing basis by the Laboratory of Ecology and Adaptation of Plants of the University of Łódź. The subject of monitoring are selected species of plants and natural habitat that occur in the northern part of the reserve. It is carried out to analyse the ecological effects of reduction of the tree stand and understorey in the northern part of the reserve. It was carried out to create conditions for the regeneration of xerothermic vegetation, revival of habitats and increase of protected plants population. Due to the fact that the area is a place of valuable plant species it is necessary to assess the effect of the treatment on the elements of plant cover.

Monitoring of the protection of monuments is conducted by Voivode Office of Monuments’ Protection in Kielce (in particular facilities and areas entered into the register of monuments).

Coordination of administrative arrangements for component parts 2, 3 and 4 is underway as part of the Management Plan (2018, in progress). Those component parts (Borownia and Korycizna) with forest cover that is under administration by the State Forest Agency, are monitored (for relevant aspects) by rangers from Ostrowiec Świętokrzyski forest district.
6.c Results of Previous Reporting Exercises

Elements of the property entered into the register of the monuments possess documentation in the form of so-called White Cards, which are stored in the Voivode Office of Monument Protection in Kielce and the National Institute of Heritage in Warsaw.

Elements of the property entered into the Commune Register of Monuments possess documentation in the form of address cards of the immovable monument and are stored in the office of the Poviate Conservator of Monuments.

For more information see chapter 7.c.

It can therefore be said that over 4000 years ago, in the area of today’s Ćmielów, there developed an intensive economic activity based not only on farming but also on mining and crafting which was accompanied by trade. /…/

The idea of placing the Neolithic striped flint mines and the settlement in Gawroniec as one unit in the UNESCO World Heritage List is of great significance for the authorities of the Ćmielów Commune. We perceive it as an opportunity to protect the archaeological sites, making them available to the public as well as to promote and develop our Commune.

Jan Kuśmierz
Mayor of Ćmielów City and Commune
7. Documentation

7.1. Documentation - Provincial Heritage Monuments Protection in Kielce archive
### 7.a List of Photographs and Audiovisual Materials and Authorisation Form for their Use

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<th>Contact details of copyright owner</th>
<th>Non-exclusive cession of rights</th>
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<tbody>
<tr>
<td>1.</td>
<td>.jpg</td>
<td>Krzemionki Opatowskie Mining Field. Interpretative exhibit reconstruction of exploitation in niche mine 6/668 on visitor route.</td>
<td>07/2012</td>
<td>Krzysztof Pęczalski</td>
<td>K. Pęczalski/Historical and Archaeological Museum in Ostrowiec Świętokrzyski</td>
<td><a href="mailto:krzysztof.pczalski@gmail.com">krzysztof.pczalski@gmail.com</a> <a href="mailto:sekretariat@krzemionki.info">sekretariat@krzemionki.info</a></td>
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<td>2.</td>
<td>.jpg</td>
<td>Krzemionki Opatowskie Mining Field. Fragment of burnt pinewood torch found in situ during exploration in 2003.</td>
<td>2003</td>
<td>Jerzy Tomasz Bąbel</td>
<td>J. T. Bąbel/Historical and Archaeological Museum in Ostrowiec Świętokrzyski</td>
<td><a href="mailto:tbabel@poczta.onet.pl">tbabel@poczta.onet.pl</a> <a href="mailto:sekretariat@krzemionki.info">sekretariat@krzemionki.info</a></td>
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<td>3.</td>
<td>.jpg</td>
<td>Krzemionki Opatowskie Mining Field. The Great Chambers. Exploration of an antler tool during archaeological research in 2009.</td>
<td>08/2009</td>
<td>Artur Jedynak</td>
<td>A. Jedynak/Historical and Archaeological Museum in Ostrowiec Świętokrzyski</td>
<td><a href="mailto:artur.archeo@krzemionki.info">artur.archeo@krzemionki.info</a> <a href="mailto:sekretariat@krzemionki.info">sekretariat@krzemionki.info</a></td>
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<td>4.</td>
<td>.jpg</td>
<td>Krzemionki Opatowskie Mining Field. Fragment of an antler tool explored in situ during excavation in The Great Chambers in 2009.</td>
<td>08/2009</td>
<td>Artur Jedynak</td>
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<td>5.</td>
<td>.jpg</td>
<td>Krzemionki Opatowskie Mining Field. Chamber mine 7/610. Communication gallery between back-filled limestone rubble.</td>
<td>04/2012</td>
<td>Krzysztof Pęczalski</td>
<td>K. Pęczalski/Historical and Archaeological Museum in Ostrowiec Świętokrzyski</td>
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<td>6.</td>
<td>.jpg</td>
<td>Krzemionki Opatowskie Mining Field. Antler tool found in situ during exploration in mine 824, The Great Chambers.</td>
<td>10/2008</td>
<td>Kamil Kaptur</td>
<td>K. Kaptur/Historical and Archaeological Museum in Ostrowiec Świętokrzyski</td>
<td><a href="mailto:kamil.archeo@krzemionki.info">kamil.archeo@krzemionki.info</a> <a href="mailto:sekretariat@krzemionki.info">sekretariat@krzemionki.info</a></td>
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<td>7.</td>
<td>.jpg</td>
<td>Krzemionki Opatowskie Mining Field. Traces of mining tool on sidewall in Great Chambers district. Excavation in 2009.</td>
<td>01/2009</td>
<td>Artur Jedynak</td>
<td>A. Jedynak/ Historical and Archaeological Museum in Ostrowiec Świętokrzyski</td>
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<td>8.</td>
<td>.jpg</td>
<td>Krzemionki Opatowskie Mining Field. Stone mining tool (wedge) in situ. Great Chamber area.</td>
<td>09/2009</td>
<td>Artur Jedynak</td>
<td>A. Jedynak/ Historical and Archaeological Museum in Ostrowiec Świętokrzyski</td>
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<td>9.</td>
<td>.jpg</td>
<td>Krzemionki Opatowskie Mining Field. Striped flint mining tool in situ.</td>
<td>08/2009</td>
<td>Artur Jedynak</td>
<td>A. Jedynak/ Historical and Archaeological Museum in Ostrowiec Świętokrzyski</td>
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<td>Krzemionki Opatowskie Mining Field. Fragment of an antler wedge in situ discovered in limestone rubble.</td>
<td>09/2009</td>
<td>Kamil Kaptur</td>
<td>K. Kaptur/ Historical and Archaeological Museum in Ostrowiec Świętokrzyski</td>
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<td>Krzemionki Opatowskie Mining Field. Fragment of an antler tool explored in situ.</td>
<td>08/2009</td>
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<td>Krzemionki Opatowskie Mining Field. The Great Chambers. Sidewall with signs of picking.</td>
<td>10/2008</td>
<td>Artur Jedynak</td>
<td>A. Jedynak/ Historical and Archaeological Museum in Ostrowiec Świętokrzyski</td>
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<td>Krzemionki Opatowskie Mining Field. Striped flint nodule in situ exposed in visitor gallery.</td>
<td>11/2012</td>
<td>Krzysztof Pęczalski</td>
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<td>Krzemionki Opatowskie Mining Field. Fragment of a pillar with Neolithic charcoal drawing seen from tourist route.</td>
<td>04/2012</td>
<td>Krzysztof Pęczalski</td>
<td>K. Pęczalski/ Historical and Archaeological Museum in Ostrowiec Świętokrzyski</td>
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<td>Krzemionki Opatowskie Mining Field. Communication gallery in chamber mine 7/610.</td>
<td>04/2012</td>
<td>Krzysztof Pęczalski</td>
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<td>Krzemionki Opatowskie Mining Field. Nodule of striped flint in solid lime-stone seen from visitor access level.</td>
<td>04/2012</td>
<td>Krzysztof Pęczalski</td>
<td>K. Pęczalski/ Historical and Archaeological Museum in Ostrowiec Świętokrzyski</td>
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<td>Krzemionki Opatowskie Mining Field. Visitor route, interpretative demonstrating of mining methods in original niche mine 6/668.</td>
<td>04/2012</td>
<td>Krzysztof Pęczalski</td>
<td>K. Pęczalski/ Historical and Archaeological Museum in Ostrowiec Świętokrzyski</td>
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<td>Krzemionki Opatowskie Mining Field. Striped flint concretion with internal banded structure.</td>
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<td>Krzysztof Pęczalski</td>
<td>K. Pęczalski/ Historical and Archaeological Museum in Ostrowiec Świętokrzyski</td>
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<td>19.</td>
<td>.jpg</td>
<td>Krzemionki Opatowskie Mining Field. Pillar-chamber mine, visitor access level.</td>
<td>11/2003</td>
<td>Grzegorz Ciżdziel</td>
<td>G. Ciżdziel/ Historical and Archaeological Museum in Ostrowiec Świętokrzyski</td>
<td><a href="mailto:gcizdziel@poczta.fm">gcizdziel@poczta.fm</a> <a href="mailto:sekretariat@krzemionki.info">sekretariat@krzemionki.info</a></td>
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<td>Krzemionki Opatowskie Mining Field. Pillar-chamber mine. Carbon marks from scraping a piece of burnt torch seen from visitor route.</td>
<td>04/2012</td>
<td>Krzysztof Pęczalski</td>
<td>K. Pęczalski/ Historical and Archaeological Museum in Ostrowiec Świętokrzyski</td>
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<td>Krzemionki Opatowskie Mining Field. Pillar-chamber mine, visitor access level.</td>
<td>04/2012</td>
<td>Krzysztof Pęczalski</td>
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<td>Krzemionki Opatowskie Mining Field. Chamber mine 7/610. Communication gallery between waste limestone ruble.</td>
<td>04/2012</td>
<td>Krzysztof Pęczalski</td>
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<td>Krzemionki Opatowskie Mining Field. Chamber mine. Bottom of shaft 615.</td>
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<td>Krzemionki Opatowskie Mining Field. Communication gallery between waste ruble reached the ceiling in chamber mine 795.</td>
<td>01/2002</td>
<td>Jerzy Tomasz Bąbel</td>
<td>J. T. Bąbel/ Historical and Archaeological Museum in Ostrowiec Świętokrzyski</td>
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<td>Krzemionki Opatskowe Mining Field. Chamber mine at the bottom of shaft 615.</td>
<td>11/2016</td>
<td>Andrzej Łada</td>
<td>A. Łada/ Historical and Archaeological Museum in Ostrowiec Świętokrzyski</td>
<td><a href="mailto:sekretariat@krzemionki.info">sekretariat@krzemionki.info</a> <a href="mailto:andrzej_lada@o2.pl">andrzej_lada@o2.pl</a></td>
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<td>Krzemionki Opatskowe Mining Field. Chamber mine 7/610. Communication gallery with waste limestone rubble.</td>
<td>04/2012</td>
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<td>Krzemionki Opatskowe Mining Field. Landscape of shaft hollows and tips of shaft sinking and mining debris.</td>
<td>04/2012</td>
<td>Krzysztof Pęczalski</td>
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<td>Krzemionki Opatskowe Mining Field. Neolithic 'industrial landscape' at surface.</td>
<td>02/2017</td>
<td>Artur Jedynak</td>
<td>A. Jedynak/ Historical and Archaeological Museum in Ostrowiec Świętokrzyski</td>
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<td>Krzemionki Opatskowe Mining Field. Visible shaft hollows and remains of slag heaps, post-mining landscape.</td>
<td>02/2017</td>
<td>Artur Jedynak</td>
<td>A. Jedynak/ Historical and Archaeological Museum in Ostrowiec Świętokrzyski</td>
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<td>31.</td>
<td>.jpg</td>
<td>Krzemionki Opatskowe Mining Field. A viewing platform over Neolithic exploitation field between pavilions on visitor route.</td>
<td>11/2012</td>
<td>Krzysztof Pęczalski</td>
<td>K. Pęczalski/ Historical and Archaeological Museum in Ostrowiec Świętokrzyski</td>
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<td>Krzemionki Opatskowe Mining Field. Visitor route. Interpretive reconstruction over chamber mine shaft 7/610 based on archaeological excavation.</td>
<td>04/2012</td>
<td>Krzysztof Pęczalski</td>
<td>K. Pęczalski/ Historical and Archaeological Museum in Ostrowiec Świętokrzyski</td>
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<td>Krzemionki Opatskowe Mining Field. Interpretive reconstruction of entrance to the shaft over chamber mine 7/610.</td>
<td>04/2012</td>
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<td>34.</td>
<td>.jpg</td>
<td>Krzemionki Opatowskie Mining Field. Shaft pavilions on tourist route.</td>
<td>04/2012</td>
<td>Krzysztof Pęczalski</td>
<td>K. Pęczalski/ Historical and Archaeological Museum in Ostrowiec Świętokrzyski</td>
<td><a href="mailto:krzysztof.pczalski@gmail.com">krzysztof.pczalski@gmail.com</a> <a href="mailto:sekretariat@krzemionki.info">sekretariat@krzemionki.info</a></td>
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<td>35.</td>
<td>.jpg</td>
<td>Krzemionki Opatowskie. The new Museum exhibition center building and its surroundings.</td>
<td>04/2012</td>
<td>Krzysztof Pęczalski</td>
<td>K. Pęczalski/ Historical and Archaeological Museum in Ostrowiec Świętokrzyski</td>
<td><a href="mailto:krzysztof.pczalski@gmail.com">krzysztof.pczalski@gmail.com</a> <a href="mailto:sekretariat@krzemionki.info">sekretariat@krzemionki.info</a></td>
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<td>36.</td>
<td>.jpg</td>
<td>Krzemionki Opatowskie. Exhibition in main museum gallery.</td>
<td>07/2016</td>
<td>Krzysztof Pęczalski</td>
<td>K. Pęczalski/ Historical and Archaeological Museum in Ostrowiec Świętokrzyski</td>
<td><a href="mailto:krzysztof.pczalski@gmail.com">krzysztof.pczalski@gmail.com</a> <a href="mailto:sekretariat@krzemionki.info">sekretariat@krzemionki.info</a></td>
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<td>37.</td>
<td>.jpg</td>
<td>Krzemionki Opatowskie. Museum exhibition in temporary gallery.</td>
<td>06/2012</td>
<td>Artur Jedynak</td>
<td>A. Jedynak/ Historical and Archaeological Museum in Ostrowiec Świętokrzyski</td>
<td><a href="mailto:artur.archeo@krzemionki.info">artur.archeo@krzemionki.info</a> <a href="mailto:sekretariat@krzemionki.info">sekretariat@krzemionki.info</a></td>
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<td>38.</td>
<td>.jpg</td>
<td>Krzemionki Opatowskie. Museum exhibits of clay pottery from Late Neolithic Period (mid-third millennium B.C.).</td>
<td>06/2012</td>
<td>Kamil Stelmasik</td>
<td>K. Stelmasik/ Historical and Archaeological Museum in Ostrowiec Świętokrzyski</td>
<td><a href="mailto:kamil.stelmasik@gmail.com">kamil.stelmasik@gmail.com</a> <a href="mailto:sekretariat@krzemionki.info">sekretariat@krzemionki.info</a></td>
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<td>39.</td>
<td>.jpg</td>
<td>Krzemionki Opatowskie. Exhibition gallery. Chisels and bradawl made from bones and antler. Flint blades and tools.</td>
<td>05/2016</td>
<td>Dominika Zarzycka</td>
<td>D. Zarzycka/ Historical and Archaeological Museum in Ostrowiec Świętokrzyski</td>
<td><a href="mailto:d.zarzycka@gmail.com">d.zarzycka@gmail.com</a> <a href="mailto:sekretariat@krzemionki.info">sekretariat@krzemionki.info</a></td>
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<td>40.</td>
<td>.jpg</td>
<td>Krzemionki Opatowskie. Internal banded structure of striped flint.</td>
<td>04/2012</td>
<td>Krzysztof Pęczalski</td>
<td>K. Pęczalski/ Historical and Archaeological Museum in Ostrowiec Świętokrzyski</td>
<td><a href="mailto:krzysztof.pczalski@gmail.com">krzysztof.pczalski@gmail.com</a> <a href="mailto:sekretariat@krzemionki.info">sekretariat@krzemionki.info</a></td>
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<td>41.</td>
<td>.jpg</td>
<td>Borownia Mining Field. Western part of mining field.</td>
<td>03/2017</td>
<td>Artur Jedynak</td>
<td>A. Jedynak/ Historical and Archaeological Museum in Ostrowiec Świętokrzyski</td>
<td><a href="mailto:artur.archeo@krzemionki.info">artur.archeo@krzemionki.info</a> <a href="mailto:sekretariat@krzemionki.info">sekretariat@krzemionki.info</a></td>
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<td>42.</td>
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<td>Borownia Mining Field. Central part of mining field.</td>
<td>01/2018</td>
<td>Artur Jedynak</td>
<td>A. Jedynak/ Historical and Archaeological Museum in Ostrowiec Świętokrzyski</td>
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<td>Date of Photo (mo/yr)</td>
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<td>Contact details of copyright owner</td>
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<td>43.</td>
<td>jpg</td>
<td>Borownia Mining Field. Eastern part of mining field.</td>
<td>01/2018</td>
<td>Artur Jedynak</td>
<td>Historical and Archaeological Museum in Ostrowiec Świętokrzyski</td>
<td><a href="mailto:artur.archeo@krzemionki.info">artur.archeo@krzemionki.info</a> <a href="mailto:sekretariat@krzemionki.info">sekretariat@krzemionki.info</a></td>
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<td>44.</td>
<td>jpg</td>
<td>Borownia Mining Field. Post-mining landscape. Visible shaft hollows and slag heaps.</td>
<td>11/2012</td>
<td>Jacek Lech</td>
<td>Historical and Archaeological Museum in Ostrowiec Świętokrzyski</td>
<td><a href="mailto:flint.lech2@gmail.com">flint.lech2@gmail.com</a> <a href="mailto:sekretariat@krzemionki.info">sekretariat@krzemionki.info</a></td>
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<td>45.</td>
<td>jpg</td>
<td>Borownia Mining Field. Excavation of shaft 1 in 2017.</td>
<td>07/2017</td>
<td>Jacek Lech</td>
<td>Historical and Archaeological Museum in Ostrowiec Świętokrzyski</td>
<td><a href="mailto:flint.lech2@gmail.com">flint.lech2@gmail.com</a> <a href="mailto:sekretariat@krzemionki.info">sekretariat@krzemionki.info</a></td>
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<td>46.</td>
<td>jpg</td>
<td>Borownia Mining Field. Semi-product of flint axe.</td>
<td>08/2017</td>
<td>Jacek Lech</td>
<td>Historical and Archaeological Museum in Ostrowiec Świętokrzyski</td>
<td><a href="mailto:flint.lech2@gmail.com">flint.lech2@gmail.com</a> <a href="mailto:sekretariat@krzemionki.info">sekretariat@krzemionki.info</a></td>
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<td>47.</td>
<td>jpg</td>
<td>Korycizna Mining Field. Mine tip.</td>
<td>01/2018</td>
<td>Artur Jedynak</td>
<td>Historical and Archaeological Museum in Ostrowiec Świętokrzyski</td>
<td><a href="mailto:artur.archeo@krzemionki.info">artur.archeo@krzemionki.info</a> <a href="mailto:sekretariat@krzemionki.info">sekretariat@krzemionki.info</a></td>
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<td>48.</td>
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<td>Korycizna Mining Field. Mine tip.</td>
<td>01/2018</td>
<td>Artur Jedynak</td>
<td>Historical and Archaeological Museum in Ostrowiec Świętokrzyski</td>
<td><a href="mailto:artur.archeo@krzemionki.info">artur.archeo@krzemionki.info</a> <a href="mailto:sekretariat@krzemionki.info">sekretariat@krzemionki.info</a></td>
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<td>49.</td>
<td>jpg</td>
<td>Korycizna Mining Field. Prehistoric 'industrial landscape' at surface.</td>
<td>01/2018</td>
<td>Artur Jedynak</td>
<td>Historical and Archaeological Museum in Ostrowiec Świętokrzyski</td>
<td><a href="mailto:artur.archeo@krzemionki.info">artur.archeo@krzemionki.info</a> <a href="mailto:sekretariat@krzemionki.info">sekretariat@krzemionki.info</a></td>
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<td>50.</td>
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<td>Korycizna Mining Field. Surface of western part of archaeological site.</td>
<td>01/2018</td>
<td>Artur Jedynak</td>
<td>Historical and Archaeological Museum in Ostrowiec Świętokrzyski</td>
<td><a href="mailto:artur.archeo@krzemionki.info">artur.archeo@krzemionki.info</a> <a href="mailto:sekretariat@krzemionki.info">sekretariat@krzemionki.info</a></td>
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<td>51.</td>
<td>jpg</td>
<td>Korycizna Mining Field. Western edge of mining field.</td>
<td>01/2018</td>
<td>Artur Jedynak</td>
<td>Historical and Archaeological Museum in Ostrowiec Świętokrzyski</td>
<td><a href="mailto:artur.archeo@krzemionki.info">artur.archeo@krzemionki.info</a> <a href="mailto:sekretariat@krzemionki.info">sekretariat@krzemionki.info</a></td>
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<td>52.</td>
<td>.jpg</td>
<td>Gawroniec Hill. Aerial photo of archaeological site.</td>
<td>06/2010</td>
<td>Miron Bogacki</td>
<td>M. Bogacki/ Historical and Archaeological Museum in Ostrowiec Świętokrzyski</td>
<td><a href="mailto:miron.bogacki@uw.edu.pl">miron.bogacki@uw.edu.pl</a> <a href="mailto:sekretariat@krzemionki.info">sekretariat@krzemionki.info</a></td>
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<td>53.</td>
<td>.jpg</td>
<td>Gawroniec Hill. View of settlement from north-east.</td>
<td>01/2018</td>
<td>Artur Jedynak</td>
<td>A. Jedynak/ Historical and Archaeological Museum in Ostrowiec Świętokrzyski</td>
<td><a href="mailto:artur.archeo@krzemionki.info">artur.archeo@krzemionki.info</a> <a href="mailto:sekretariat@krzemionki.info">sekretariat@krzemionki.info</a></td>
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<td>54.</td>
<td>.jpg</td>
<td>Gawroniec Hill. View of settlement from south.</td>
<td>01/2018</td>
<td>Artur Jedynak</td>
<td>A. Jedynak/ Historical and Archaeological Museum in Ostrowiec Świętokrzyski</td>
<td><a href="mailto:artur.archeo@krzemionki.info">artur.archeo@krzemionki.info</a> <a href="mailto:sekretariat@krzemionki.info">sekretariat@krzemionki.info</a></td>
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<td>55.</td>
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<td>Gawroniec Hill. View of settlement from south-east.</td>
<td>01/2018</td>
<td>Artur Jedynak</td>
<td>A. Jedynak/ Historical and Archaeological Museum in Ostrowiec Świętokrzyski</td>
<td><a href="mailto:artur.archeo@krzemionki.info">artur.archeo@krzemionki.info</a> <a href="mailto:sekretariat@krzemionki.info">sekretariat@krzemionki.info</a></td>
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<td>56.</td>
<td>.jpg</td>
<td>Gawroniec Hill. View of settlement from west.</td>
<td>01/2018</td>
<td>Artur Jedynak</td>
<td>A. Jedynak/ Historical and Archaeological Museum in Ostrowiec Świętokrzyski</td>
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<td>57.</td>
<td>.jpg</td>
<td>Gawroniec Hill. Kamienna valley view.</td>
<td>06/2008</td>
<td>Jacek Lech</td>
<td>J. Lech/ Historical and Archaeological Museum in Ostrowiec Świętokrzyski</td>
<td><a href="mailto:flint.lech2@gmail.com">flint.lech2@gmail.com</a> <a href="mailto:sekretariat@krzemionki.info">sekretariat@krzemionki.info</a></td>
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<td>58.</td>
<td>.mp4</td>
<td>Film. English version, 720p</td>
<td>2016</td>
<td>Robert Kuliczkowski; Polska na Weekend</td>
<td>R. Kuliczkowski/ Historical and Archaeological Museum in Ostrowiec Świętokrzyski</td>
<td><a href="mailto:telewizja@polskanaweekend.tv">telewizja@polskanaweekend.tv</a> <a href="mailto:sekretariat@krzemionki.info">sekretariat@krzemionki.info</a></td>
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<td>59.</td>
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<td>Robert Kuliczkowski; Polska na Weekend</td>
<td>R. Kuliczkowski/ Historical and Archaeological Museum in Ostrowiec Świętokrzyski</td>
<td><a href="mailto:telewizja@polskanaweekend.tv">telewizja@polskanaweekend.tv</a> <a href="mailto:sekretariat@krzemionki.info">sekretariat@krzemionki.info</a></td>
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<td>60.</td>
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<td>Film. Polish version, 720p.</td>
<td>2016</td>
<td>Robert Kuliczkowski; Polska na Weekend</td>
<td>R. Kuliczkowski/ Historical and Archaeological Museum in Ostrowiec Świętokrzyski</td>
<td><a href="mailto:telewizja@polskanaweekend.tv">telewizja@polskanaweekend.tv</a> <a href="mailto:sekretariat@krzemionki.info">sekretariat@krzemionki.info</a></td>
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<td>61.</td>
<td>.mp4</td>
<td>Film. Polish version, Flint stone story.</td>
<td>2016</td>
<td>Anna Pankiewicz, Marcin Kaproń</td>
<td>A. Pankiewicz, M. Kaproń/ Historical and Archaeological Museum in Ostrowiec Świętokrzyski</td>
<td><a href="mailto:marcin@fnu.org.pl">marcin@fnu.org.pl</a> <a href="mailto:sekretariat@krzemionki.info">sekretariat@krzemionki.info</a></td>
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<td>62.</td>
<td>.mp4</td>
<td>Underground 3D scanning</td>
<td>2016-2017</td>
<td>GeoCartis Company</td>
<td>GeoCartis/ Historical and Archaeological Museum in Ostrowiec Świętokrzyski</td>
<td><a href="mailto:skaning@geocartis.pl">skaning@geocartis.pl</a> <a href="mailto:sekretariat@krzemionki.info">sekretariat@krzemionki.info</a></td>
<td>Yes</td>
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7.b Texts Concerning the Status of Protection, Copies of Property Management or Documentation of Management Systems and Excerpts from other Plans Relating to a Property

Annex 2

Protective Designation

1. Pomnik historii Krzemionki – kopalnie krzemienia z epoki neolitu [Memorial of History Krzemionki – Neolithic era flint mines]
   Regulation of the President of the Republic of Poland of 8 September 1994, the Official Journal of the Republic of Poland ‘Monitor Polski’ no. 50 item 419

2. Teren pradziejowej kopalni krzemienia pasiastego położonej w miejscowościach Sudół, Stoki Stare i Ruda Kościelna [area of prehistoric striped flint mine located in Sudół, Stoki Stare and Ruda Kościelna villages]
   a) Decision of 27 May 1967 by the Voivodeship Monument Inspector (Conservator) to entry the monument into the Register of monuments, register no. A1 l 499/1Aa
   b) Decision of 1 September 1986 by the Voivodeship Monument Inspector (Conservator) to renew the entry the monument into the Register of monuments, register no. A1 l 499/1Aa
   c) Change of the Voivodeship Monument Inspector’s (Conservator’s) decision regarding name and boundaries of registered monument, 15 December 1999
3. Pozostałości prehistorycznej kopalni krzemienia piasiastego „Borownia” w Rudzie Kościelnej
[The remains of prehistoric striped flint mine ‘Borownia’ in Ruda Kościelna]
Decision of 15 September 1981 by the Voivodeship Monument Inspector (Conservator) to entry the monument into the Register of monuments, register no. A 260

4. Kopalnia krzemienia piasiastego „Korycizna” we wsi Wojciechówka [Striped flint mine ‘Korycizna’ in Wojciechówka village]
Decision of 15 July 1982 by the Voivodeship Monument Inspector (Conservator) to entry the monument into the Register of monuments, register no. A 265

5. Zawiadomienie o wszczęciu postępowania w sprawie wpisu do rejestru zabytków archeologicznych stanowiska archeologicznego Ćmielów 1/1 „Gawroniec” [Notification on the initiation of proceedings regarding the entry of an archaeological site in the register of archaeological monuments], Voivodeship Monument Inspector’s (Conservator) letter of 25 October 2017

6. Krzemionki Opatowskie Natura 2000 Site of Community Importance (SCI)
   PLH 260024 data form

7. Dolina Kamiennej Natura 2000 Site of Community Importance (SCI)
   PLH 260019 data form

   a) Order of the Minister of Environmental Protection, Natural Resources and Forestry of 27 June 1995; the Official Journal of the Republic of Poland ‘Monitor Polski’ no. 33 of 1995, item 396
   b) Order of the Regional director for environmental protection in Kielce of 20 September 2017 r. regarding nature reserve Krzemionki Opatowskie, Journal of Laws of Świętokrzyskie Voivodeship of 26 September 2017, item 2911

9. Obszar chronionego krajobrazu doliny Kamiennej [area of protected landscape of the Kamienna River Valley]
   Regulation no. 12/95 of the Governor of Kielce province of 29 September 1995 r., Journal of Laws of Kieleckie Voivodeship no. 21 of 1995, item 145
### 7.c Form and Date of Taking an Inventory of Properties

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<th>Title</th>
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<td>1.</td>
<td>Sprawozdanie z badań archeologicznych przeprowadzonych na stan. 10/18 w Rudzie Kościelnej, gm. Ćmielów (kopalnia krzemienia piasistego „Borownia”; Lech J. (w opracowaniu do 2018) (Summary: Report on archaeological research conducted in the site 10/18 in Ruda Kościelna, Ćmielów commune (Striped flint mine 'Borownia'))</td>
<td>2017</td>
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<td>3.</td>
<td>Dokumentacja prac górniczo-konserwatorskich i związanych z nimi wyprzedzających badań archeologicznych w rejonie Wielkich Komóř, szybu wentylacyjno-ewakuacyjnego, szybu „Zenon” oraz podziemnej trasy turystycznej w 2014 roku; Jedynak A., Kaptur K., archiwum Wojewódzkiego Urzędu Ochrony Zabytków w Kielcach (Study documentation of excavation and renovation works and archaeological studies preceding them conducted in 2014 around Wielkie Komory, ventilation/evacuation shaft, ‘Zenon’ shaft and underground tourist route.)</td>
<td>2014</td>
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<td>4.</td>
<td>Sprawozdanie z badań nieinwazyjnych i powierzchniowych na obszarze prehistorycznej kopalni krzemienia piasistego „Borownia” i w jej otoczeniu, stanowisko archeologiczne Ruda Kościelna 10 (AZP 84-72/18) gm. Ćmielów, woj. świętokrzyskie w dn. 17 kwietnia 2012 r. z wykorzystaniem obserwacji i dokumentacji stanowiska z lat 2008, 2009 i 2011; Adamczak K., Lech J., Werra D, archiwum Wojewódzkiego Urzędu Ochrony Zabytków w Kielcach (Summary: Report on non-invasive and surface studies conducted at the ‘Borownia’ prehistoric striped flint mine and in its vicinity, archaeological site Ruda Kościelna 10 (AZP 84-72/18), Ćmielów commune, Świętokrzyskie voivodeship on 17 April 2012, using documentation and observations of the site from 2008, 2009 and 2010.)</td>
<td>2012</td>
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<td>5.</td>
<td>Raport o stanie zachowania zabytkowych podziemi w Krzemionkach koło Ostrowca Świętokrzyskiego; Jedynak A., Kaptur K., archiwum Muzeum Historyczno-Archeologicznego w Ostrowcu Świętokrzyskim (Report on the conservation status of the historic undergrounds of Krzemionki near Ostrowiec Świętokrzyski)</td>
<td>2012</td>
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<td>6.</td>
<td>Opracowanie archeologiczne wyników projektu „Dokumentacja zagrożonych kopalń krzemienia piasistego metodami nieinwazyjnymi; Migal W., archiwum Wojewódzkiego Urzędu Ochrony Zabytków w Kielcach (Archaeological study on the results of the project: ‘Documentation of endangered striped flint mines using non-invasive methods’)</td>
<td>2011</td>
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<td>7.</td>
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7.d Addresses at which the Inventories, Documentation and Archival Documents are Stored

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<td>Urząd Marszałkowski Województwa Świętokrzyskiego (Marshal's Office of Świętokrzyskie Voivodeship)</td>
<td>al. IX Wieków Kielc 3 25-516 Kielce tel.: +48 41 342 18 78 e-mail: <a href="mailto:kancelaria@sejmik.kielce.pl">kancelaria@sejmik.kielce.pl</a></td>
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<td>9.</td>
<td>Starostwo Powiatowe w Ostrowcu Świętokrzyskim (District Office in Ostrowiec Świętokrzyski)</td>
<td>ul. Ilżecka 37 27-400 Ostrowiec Świętokrzyski tel.: +48 41 247 66 10 e-mail: <a href="mailto:starostwo@powiat.ostrowiecki.eu">starostwo@powiat.ostrowiecki.eu</a></td>
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<td>10.</td>
<td>Starostwo Powiatowe w Opatowie (District Office in Opatów)</td>
<td>ul. Sienkiewicza 17 27-500 Opatów tel.: +48 15 868 29 71 e-mail: <a href="mailto:powiat@opatow.pl">powiat@opatow.pl</a></td>
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<td>11.</td>
<td>Regionalna Dyrekcja Ochrony Środowiska w Kielcach (Regional Directorate for Environmental Protection in Kielce)</td>
<td>ul. Szymanowskiego 6 25-361 Kielce tel.: +48 41 343 53 40 e-mail: <a href="mailto:sekretariat.kielce@rdos.gov.pl">sekretariat.kielce@rdos.gov.pl</a></td>
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<td>12.</td>
<td>Regionalna Dyrekcja Lasów Państwowych w Radomiu (Regional Directorate of State Forests in Radom)</td>
<td>ul. 25 czerwca 68 26-600 Radom tel.: +48 48 385 60 00 e-mail: <a href="mailto:rdlp@radom.lasy.gov.pl">rdlp@radom.lasy.gov.pl</a></td>
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<td>13.</td>
<td>Nadleśnictwo Ostrowiec Świętokrzyski (Ostrowiec Świętokrzyski Forest District)</td>
<td>Sudół 216 27-400 Ostrowiec Świętokrzyski tel.: +48 41 265 31 49 e-mail: <a href="mailto:ostrowiec@radom.lasy.gov.pl">ostrowiec@radom.lasy.gov.pl</a></td>
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<td>14.</td>
<td>Urząd Gminy Bodzechów (Commune Office of Bodzechów)</td>
<td>ul. Reja 10 27-400 Ostrowiec Świętokrzyski tel.: +48 41 265 38 38 e-mail: <a href="mailto:urzad@ugb.pl">urzad@ugb.pl</a></td>
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<td>15.</td>
<td>Urząd Miasta i Gminy Ćmielów (Municipality and the Communal Office in Ćmielów)</td>
<td>ul. Ostrowiecka 40 27-440 Ćmielów tel.: +48 15 861 20 18 e-mail: <a href="mailto:urzad@cmielow.pl">urzad@cmielow.pl</a></td>
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<td>16.</td>
<td>Urząd Miejski w Ożarowie (Municipality and the Communal Office of Ożarów)</td>
<td>ul. Stodolna 1 27-530 Ożarów tel.: + 48 15 861 11 37 e-mail: <a href="mailto:urzad@ozarow.pl">urzad@ozarow.pl</a></td>
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## 8.c Other Local Institutions

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<thead>
<tr>
<th>No.</th>
<th>Institution</th>
<th>Address</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Regionalna Organizacja Turystyczna Województwa Świętokrzyskiego</td>
<td>ul. Ściegiennego 2 pok. 36 25-033 Kielce tel.: +48 41 361 80 57 e-mail: <a href="mailto:rot@swietokrzyskie.travel">rot@swietokrzyskie.travel</a></td>
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<td>2.</td>
<td>Wyższa Szkoła Biznesu i Przedsiębiorczości w Ostrowcu Świętokrzyskim</td>
<td>ul. Akademicka 12 27-400 Ostrowiec Świętokrzyski tel.: +48 41 260 40 41 e-mail: <a href="mailto:info@wsbip.edu.pl">info@wsbip.edu.pl</a></td>
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<tr>
<td>3.</td>
<td>Stowarzyszenie Lokalna Grupa Działania „Krzemienny Krąg”</td>
<td>Bałtów 55 27-423 Bałtów tel.: +48 41 252 72 33 e-mail: <a href="mailto:biuro@krzemienykrag.info">biuro@krzemienykrag.info</a></td>
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<td>4.</td>
<td>Stowarzyszenie Delta</td>
<td>ul. Sandomierska 4 27-400 Ostrowiec Świętokrzyski tel.: +48 41 247 91 12 e-mail: <a href="mailto:biuro@jurapark.pl">biuro@jurapark.pl</a></td>
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<tr>
<td>5.</td>
<td>Stowarzyszenie Na Rzecz Rozwoju Gminy Bałtów „Bałt”</td>
<td>Bałtów 55 27-423 Bałtów tel.: +48 41 264 12 93 e-mail: <a href="mailto:biuro@baltow.info">biuro@baltow.info</a></td>
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<tr>
<td>6.</td>
<td>Oddział Świętokrzyski PTTK im. S. Jeżewskiego w Ostrowcu Świętokrzyskim</td>
<td>al. 3 Maja 5 27-400 Ostrowiec Świętokrzyski tel.: +48 41 265 25 24 e-mail: <a href="mailto:poczta@jezewski.ostrowiec.pttk.pl">poczta@jezewski.ostrowiec.pttk.pl</a></td>
</tr>
<tr>
<td>7.</td>
<td>Miejskie Centrum Kultury w Ostrowcu Świętokrzyskim</td>
<td>ul. Siennieńska 54 27-400 Ostrowiec Świętokrzyski tel.: +48 41 247 65 80 e-mail: <a href="mailto:mckostr@mck.ostrowiec.pl">mckostr@mck.ostrowiec.pl</a></td>
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<td>8.</td>
<td>Żywe Muzeum Porcelany w Ćmielowie (Fabryka Porcelany AS Ćmielów)</td>
<td>ul. Sandomierska 243 27-440 Ćmielów tel. +48 15 861 20 21 e-mail: <a href="mailto:turystyka@cmielow.com.pl">turystyka@cmielow.com.pl</a></td>
</tr>
<tr>
<td>9.</td>
<td>Świętokrzyskie Stowarzyszenie Dziedzictwa Przemysłowego</td>
<td>ul. Ściegiennego 2 pok. 243 25-033 Kielce tel.: +48 606 828 139 e-mail: <a href="mailto:andrzejp@korzenie.gimnazjum.com.pl">andrzejp@korzenie.gimnazjum.com.pl</a></td>
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8.d Official Website

Existing websites:

www.krzemionki.pl
www.muzeumostrowiec.pl

Details of the contact:

Muzeum Historyczno-Archeologiczne w Ostrowcu Świętokrzyskim
(Historical and Archaeological Museum in Ostrowiec Świętokrzyski)
Sudół 135 a
27-400 Ostrowiec Świętokrzyski
tel.: +48 41 330 45 50
e-mail: sekretariat@krzemionki.info
9. Signature on Behalf of the State Party
Signature on behalf of the State Party
Signed on behalf of the Government of the Republic of Poland
PREHISTORIC STRIPED FLINT MINING REGION

WORLD HERITAGE NOMINATION

POLAND