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Class VI Permit Application Narrative

Claimed as PBI

Carbon America

[40 CFR 146.82(a)]

Prepared by:

Claimed as PBI a wholly owned subsidiary of Claimed as PBI

Claimed as PBI

Submitted to:

U.S. Environmental Protection Agency Region 7

Lenexa, Kansas

Revision	Date	Notes	Written By	Approved By
A	03/12/2024	Issued for Approval		R. Keeling

Claimed as PBI

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1. Attachments

See the list of attachments in the front matter.

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3.1 Introduction

Claimed as PBI

Claimed as PBI proposing the Claimed as PBI

he addition of CCS to the plant would create substantial benefits to public health and welfare and the environment by removing carbon dioxide (CO_2) from facility emissions that would otherwise be released to the atmosphere and contribute to increasing greenhouse gas emissions.

This Permit Application Narrative serves as the primary document for the Class VI permit application, and contains the main project information, site characterization, and summary of attachments. Attachments to this narrative contain specific plans and project requirements, including details for construction, operation, project conclusion, emergency response, and financial assurance.

Claimed as PBI has prepared and submitted this application for review by the U.S. Environmental Protection Agency (EPA) Region 7 for an Underground Injection Control (UIC) Class VI permit. This application has been prepared in accordance with Title 40, Part 146, of the Code of Federal Regulations (40 CFR 146), Subpart H, Criteria and Standards Applicable to Class VI Wells. An injection depth waiver is not being requested, nor is an aquifer exemption expansion.

3.2 Proposed Project

Claimed as PBI

Claimed as PBI

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Claimed as PBI produces ethanol for use as a renewable fuel through the process of fermenting feedstock. In addition to ethanol, several other products are produced by the ethanol production process, including distiller's grains for livestock and poultry, corn oils, and corn syrups.

Figure 2 demonstrates the ethanol production process. Feedstock includes raw corn from surrounding agricultural areas in Claimed as PBI . The dry corn is first milled and cooked before entering fermentation tanks, where the corn mash is fermented to produce the primary product, ethanol. During fermentation, associated gases, Claimed as PBI , with lesser parts of oxygen (O_2), are liberated and travel through a series of on-site pipes, ultimately being released to the atmosphere.

Appendix 1 presents site plans for the capture facility in relation to the Claimed as PBI .

Claimed as PBI following approval of this Class VI permit application. The well will be approximatel Claimed as PBI

Claimed as PBI will

Claimed as PBI

The delineation of the Area of Review (AoR), including the lateral and vertical extent of CO_2 plume migration and the region of corresponding pressure elevation, was completed using computational modeling, detailed in **Attachment A: Area of Review and Corrective Action Plan**. The AoR is defined as the region surrounding the injection well where underground sources of drinking water (USDWs) may be endangered by injection activity. Claimed as PBI

Claimed as PBI

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3.3 Owner/Operator Information

Claimed as PBI

- Claimed as PBI

Claimed as PBI

3.4 Facility Permitting Information

Claimed as PBI

In addition to the Class VI UIC permit, a list of relevant project permits and their status is included in Table 1.

Resource Conservation and Recovery Act (RCRA), National Emission Standards for Hazardous Pollutants (NESHAPS), Prevention of Significant Deterioration (PSD) permits, Clean Air Act (CAA) Nonattainment Program permits, and Ocean Dumping permits are not applicable to this project. This project is not located on lands currently under Bureau of Indian Lands management.

Table 1 lists all permits or construction approvals received or applied for under RCRA, the UIC program, National Pollutant Discharge Elimination System (NPDES), Prevention of Significant Deterioration (PSD) program under CAA, nonattainment program under CAA, NESHAPS preconstruction approval under CAA, and other relevant environmental permits, including state-level permits.

Table 1. Facility Permitting Information

Permit	Related Activity	Granting Authority	Status (including received or expected date)	Renewal Frequency
Claimed as PBI	Claimed as PBI	Claimed as PBI	Claimed as PBI	Claimed
Claimed as PBI			Claimed as PBI	
Claimed as PBI			Claimed as PBI	Claimed as PBI
Claimed as PBI				
Claimed as PBI			Claimed as PBI	Claimed
Claimed as PBI	Claimed as PBI	Claimed as PBI	Claimed as PBI	
Claimed as PBI	Claimed as PBI	Claimed as PBI	Claimed as PBI	Claimed as PBI
Claimed as PBI	Claimed as PBI	Claimed as PBI	Claimed as PBI	Claimed as PBI
Claimed as PBI		Claimed as PBI	Claimed as PBI	Claimed
Claimed as PBI	Claimed as PBI	Claimed as PBI	Claimed as PBI	Claimed as PBI
Claimed as PBI	Claimed as PBI	Claimed as PBI	Claimed as PBI	
Claimed as PBI	Claimed as PBI	Claimed as PBI	Claimed as PBI	Claimed

Table 1 (cont.)

Permit	Related Activity	Granting Authority	Status (including received or expected date)	Renewal Frequency
Claimed as PBI	Claimed as PBI	Claimed as PBI	Claimed as PBI	Claimed as PBI
Claimed as PBI		Claimed as PBI	Claimed as PBI	
Claimed as PBI	Claimed as PBI	Claimed as PBI	Claimed as PBI	Claimed as PBI
Claimed as PBI				
Claimed as PBI		Claimed as PBI		Claimed as PBI
Claimed as PBI	Claimed as PBI			
Claimed as PBI	Claimed as PBI	Claimed as PBI		Claimed as PBI
Claimed as PBI	Claimed as PBI	Claimed as PBI	Claimed as PBI	
Claimed as PBI	Claimed as PBI	Claimed as PBI	Claimed as PBI	
Claimed as PBI		Claimed as PBI	Claimed as PBI	

Table 1 (cont.)

Permit	Related Activity	Granting Authority	Status (including received or expected date)	Renewal Frequency
Claimed as PBI	Claimed as PBI	Claimed as PBI	Claimed as PBI	Claimed as PBI
Claimed as PBI		Claimed as PBI	Claimed as PBI	
Claimed as PBI	Claimed as PBI	Claimed as PBI	Claimed as PBI	
Claimed as PBI				
Claimed as PBI				
Claimed as PBI				
Claimed as PBI		Claimed as PBI		
Claimed as PBI		Claimed as PBI		
Claimed as PBI				
Claimed as PBI		Claimed as PBI		
Claimed as PBI		Claimed as PBI		
Claimed as PBI		Claimed as PBI		

Table 1 (cont.)

Permit	Related Activity	Granting Authority	Status (including received or expected date)	Renewal Frequency
Claimed as PBI	Claimed as PBI	Claimed as PBI	Claimed as PBI	Claimed as PBI
Claimed as PBI				Claimed as PBI
Claimed as PBI				Claimed as PBI
Claimed as PBI		Claimed as PBI		
Claimed as PBI				
Claimed as PBI		Claimed as PBI		

3.5 Public Outreach

Claimed as PBI was founded in 1900 as a station by the Claimed as PBI, and is located near many historic trails of the American West. The local economy is grounded in agriculture, oil and gas, and railroad industries. EPA's environmental justice (EJ) screening tool (EJ Screen), Department of Energy's (DOE) EJ tool (Energy Justice Mapping Tool - Disadvantaged Communities Reporter), and the Council on Environmental Quality's (CEQ) EJ tool (Climate and Economic Justice Screening Tool, CEJST) were used to assess nearby community characteristics, such as per capita income and national percentile wastewater discharge. EPA's EJ screening tool and the Energy Justice Dashboard identified an EPA IRA disadvantaged community in the Claimed as PBI. However, the CEJST tool did not identify a disadvantaged community in the Claimed as PBI area. Regardless, Claimed as PBI considered social impacts of the project when selecting the injection well location Claimed as PBI of the city. Additionally, Claimed as PBI has partnered with the Nebraska Oil and Gas Conservation Commission (NOGCC) to remediate a nearby abandoned produced water injection site with soil and groundwater contamination. Claimed as PBI hired an environmental consultant to prepare Phase I and Phase II Environmental Site Assessments, and the NOGCC will use federal orphan well funding to clean up the site. This allows Claimed as PBI project to use existing disturbance while also improving the local water resources for the community.

The location of Claimed as PBI avoids surface use conflict and population impact. The well is located on Claimed as PBI. The injection site is favorable due to ease of access to pore space rights and minimal population density, avoids material conflicts with existing rights (e.g., surface use or areas of active oil and gas production), and avoids sensitive areas and fractionation of wildlife habitat.

The project will permanently remove Claimed as PBI, equivalent to taking 35,000 passenger vehicles off the road, and will enable the Claimed as PBI to reduce the carbon intensity of ethanol production. This CCS project will increase the plant's competitiveness in the market while improving local air quality.

Claimed as PBI is committed to the project being a model of successful community relations for CCS projects, and has an inclusive outreach strategy that educates stakeholders and provides mechanisms for community feedback. Claimed as PBI Community Engagement Plan is a living document with active input from stakeholders to ensure that implemented methods are appropriate and facilitate widespread social

acceptance. This two-way engagement strategy has allowed stakeholders to participate in decisions and shape actions that benefit their local community. Since initial stakeholder analysis and early engagement with key stakeholders in 2022, outreach has continued in the community, with no formal opposition to the project.

As the project advances, Claimed as PBI will identify appropriate project agreements (community benefit agreements, memorandums of understanding, and/or good neighbor agreements) for community partnerships. This process will lay the groundwork to incorporate consent-based siting principles into the engagement plan.

Claimed as PBI has been dedicated to intentional community engagement since 2022. Multiple community meetings and open houses were conducted and over 100 one-on-one meetings with stakeholders and landowners were held. The Claimed as PBI project has also been featured in multiple local news outlets and has a project webpage with a mechanism for community feedback. Claimed as PBI has engaged with the following local community, business, and environmental groups, as well as businesses and government officials and agencies:

- Community, Business, and Environmental Groups
  - Claimed as PBI Chamber of Commerce
  - Nebraska Cattlemen (Morrill County local affiliate)
  - Claimed as PBI Rodeo Farm and Ranch Association
  - Local Religious groups
  - Society of Farm Managers and Rural Appraisers
  - Nebraska Farm Bureau
  - Seunghee Kim, a University of Nebraska engineering professor who is conducting research on CO2 sequestration at a stratigraphic well in Kearney County
  - Nature Conservancy
  - Nebraska Chapter of the Sierra Club
- Government Officials and Agencies
  - Claimed as PBI
  - Claimed as PBI
  - Emergency responders including the Sherrif, local ambulance and hospital staff
  - Six meetings with the Nebraska Oil and Gas Conservation Commission (NOGCC)
  - EPA Region 7
  - Nebraska Department of Environment and Energy (NDEE)
  - Nebraska Department of Natural Resources (DNR)
  - Nebraska Public Power District
  - Nebraska Wildlife Management
  - United States Department of Agriculture
  - Claimed as PBI Soil Conservation Natural Resources Conservation Service NRCS
  - Nebraska Department of Transportation (Highway 88)
  - Nebraska Board of Educational Funds BELF
  - State Historical Preservation Office (SHPO)
  - Nebraska Governor Jim Pillen
  - Director of the Nebraska Department of Agriculture

Claimed as PBI has started early discussions on how the CCS project can support local economic development goals and create a positive impact to local businesses, consistent with the goal to establish a strong mutually beneficial relationship with the community through two-way feedback and consent-based siting principles. Claimed as PBI envisions including job opportunities and training commitments in both construction and operation phases of the project, as well as programs to advance science, technology,

engineering, and math (STEM) education and diversity. Members of the project team have held early discussions with educators to help guide this work and ensure broad local engagement.

Claimed as PBI anticipates overlap in skills possessed by the region's existing agriculture industry and needed by the emerging CCS industry. The translation of skill sets will be highlighted in the project team's recruiting efforts both in local communities and through college and trade school recruiting.

The Claimed as PBI project will require short-term job needs in construction and engineering. A full-scope CCS project will require skilled electricians, welders, millwrights, and other specialty trades that are well-represented in the area. Permanent jobs in these fields can also be filled by individuals already employed in related roles, who will receive pre-employment or on-the-job training in skills particular to the CCS industry.

3.6 Report Organization

The following section of this Permit Application Narrative describes the site geology and characteristics that make the project area suitable for CO_2 sequestration. Sections 3 through 14 summarize detailed project plans and programs. Several sections include checkboxes for verification that required information has been submitted to the EPA through its online Geologic Sequestration Data Tool (GSDT). The various documents that make up this application have been developed based on EPA's provided templates and guidelines.

GSDT Submission - Project Background and Contact Information

GSDT Module: Project Information Tracking

Tab(s): General Information tab; Facility Information and Owner/Operator Information tab

Please use the checkbox(es) to verify the following information was submitted to the GSDT:

☒ Required project and facility details ***[40 CFR 146.82(a)(1)]***

4. Site Characterization

Geologic and hydrogeologic data presented and discussed in this section were used to develop a conceptual site model ("geomodel") for the proposed CO_2 storage site. The geomodel provides foundational data reflecting the regional and local geology surrounding Claimed as PBI. This information has been used to support the site suitability for CO_2 storage, as the geomodel exhibits adequate injection zone storage and upper confining zone integrity of sufficient areal extent to inhibit the migration of sequestered CO_2 into the project area USDWs. Additionally, the geomodel was used to facilitate the generation of the computational model discussed in **Attachment A: Area of Review and Corrective Action Plan**, and was also used to develop the design, construction, operation, and plugging of the injection and monitoring wells discussed in **Attachment B: Construction Details**.

4.1 Regional Geology, Hydrogeology, and Local Structural Geology

Claimed as PBI.

Claimed as PBI that can be mapped across the Denver-Julesburg Basin (DJ Basin) from the Colorado Front Range to Kansas. Claimed as PBI. At the Claimed as PBI

Claimed as PBI

Claimed as PBI

Claimed as PBI

4.1.a Regional Geology

By way of historical aquifer resource evaluation, mineral exploration, and hydrocarbon development, the regional geology of the DJ Basin has been well studied via the collection of well logs, cores, geophysical datasets (e.g., seismic), and outcrop studies. The following section describes the regional and local geologic structure and stratigraphy based on the aforementioned studies, with emphasis on the relevance to the Claimed as PBI Project site.

The DJ basin is a foreland sedimentary basin located east of the Rocky Mountain Front Range and encompasses parts of Colorado, Wyoming, Nebraska, and Kansas. The basin is bounded by the Apishapa Arch and Las Animas Arch to the south, Ellis Arch and Cambridge Arch to the east, and the Chadron and Hartville Uplift to the north (Figure 4). The present-day DJ Basin is a strongly asymmetric syncline with its axis positioned close to and parallel to the Front Range with a steep western limb and a gentle eastern flank (Figure 5). Structural relief from the bottom of the basin to the top of the Front Range margin is approximately 21,000 ft. The basin geometry formed primarily through tectonic processes related to the uplift of the Rocky Mountains during two major tectonic events, The Pennsylvanian Ancestral Rockies Uplift and the Cretaceous Laramide Orogeny, that provided the accommodation for sedimentation within the DJ Basin (Figure 6). The Claimed as PBI Project site is located in western Claimed as PBI on the shallower-dipping eastern flank of the DJ Basin.

DJ Basin Tectonic and Depositional Timeline

Precambrian

The Proterozoic was a time of major crustal accretion in western North America that formed the DJ Basin. The area of present-day Colorado was accreted onto the existing Archean Wyoming Province. Precambrian basement, exposed along the Colorado Front Range, is composed of Proterozoic rocks of the Yavapai tectonic province and forms the western extent of the DJ basin (Selverstone et al.,1997) and three northeast-trending Precambrian fault and shear zones: the Idaho Springs-Ralston, Moose Mountain, and the Skin Gulch shear zones (Tweto,1980; Warner, 1980). These faults are recognized as seismicity and geohazards for the oil and gas industries in the deep DJ basin in Weld County, Colorado, but do not extend to the western Claimed as PBI project area (Figure 7).

Paleozoic

Once Precambrian igneous and tectonic activity diminished, erosion of the Front Range area reduced topography to a smoothed lowland. Lower Paleozoic strata are absent from outcrops due to erosion or depositional breaks along the Front Range and in the subsurface of western Claimed as PBI near the Claimed as PBI

project area. Remnants of Cambrian, Ordovician, Devonian, and Mississippian systems are present in thin sequences in the southern Front Range.

During the Mississippian, a major north-trending land area correlating with the present day Front Range position was subjected to repeated uplift (DeVoto, 1980). Pennsylvanian fault-block uplifting along reactivated Precambrian faults resulted in mountain ranges with as much as 10,000 ft of relief, creating the Ancestral Front Range Highland (DeVoto, 1980).

The Ancestral Front Range Highland was a source area for a thick sequence of Pennsylvanian to Permian clastics deposited along its eastern margin ranging from 800 to 4,000 ft thick. Fault movement was active during the Pennsylvanian as evidenced through abrupt facies changes and thicknesses across fault boundaries. Iron-rich arkosic sandstones and conglomerates of the Fountain Formation were deposited along the ancestral Front Range uplift prograding eastward and transitioned into eolian sandstones and marginal lacustrine carbonates and shales toward an epeiric seaway to the east.

The Permian brought a decrease in uplift of the Ancestral Front Range highland and the establishment of near present-day DJ basin extents with two major subbasins: the Alliance Basin (Nebraska panhandle) and the Sterling Basin (northeastern Colorado), separated by the paleo high of the Transcontinental Arch (Figure 8). Permian deposition east of the front range within the present-day DJ basin was dominated by eolian sandstones of Claimed as PBI and sequences of evaporites. Figure 9 is a paleogeographic reconstruction of the late Permian 253 million years ago (Ma), superimposed on modern-day North America. The Rocky Mountain uplift can be clearly observed in central modern-day Colorado with northeastern trending sand to the east across eastern Colorado into Nebraska and Kansas. Claimed as PBI location is noted within the eolian deposition. The Permian ended with multiple sequences of evaporites capping the Claimed as PBI in western Claimed as PBI.

Mesozoic

The Mesozoic era was characterized by the presence of inland seas and fluctuations in relative sea levels, leading to the deposition of alternating cycles of marine sands and terrestrial mixed sediments.

The Triassic is recorded by deposition of red beds atop Permian rocks in an unconformable manner. The precise transition has been a subject of debate in literature, given that Triassic and Jurassic rocks are not visibly exposed in Nebraska but are instead traced underground to outcrops in Wyoming (Candra and Reed, 1959).

Jurassic rocks were subsequently deposited unconformably over the Triassic rocks as the Jurassic inland sea emerged. The Claimed as PBI, primarily composed of shales and sandstones, was deposited in shallow to marine systems in western Claimed as PBI. During the Late Jurassic period, the extensive terrestrial Morrison Formation was deposited across a wide expanse following a decline in relative sea levels (Bryant and Naeser, 1980).

The Cretaceous introduced a significant inland sea known as the Western Interior Seaway, stretching from the Arctic Ocean to the Gulf of Mexico. Across various sea level transgressions and regressions, a substantial sequence (>8,000 ft) of continental and marine sediments was laid down. This encompassed the Dakota Group's Lower Cretaceous sands, the Graneros and Greenhorn formations consisting of shales and limestones, Niobrara chalks and marls, and the Pierre shale (Figure 6).

Cenozoic

The Paleogene Laramide Orogeny (70 to 65 Ma) was a time of aggressive tectonism and block-fault mountain building in Colorado forming the present-day Front Range mountains and DJ Basin largely by reactivation of Late Paleozoic basement faults and shear zones (Tweto, 1980). The north-northwest orientation of the Front Range is controlled by the north-northwest Precambrian age faults. Regional uplift of the Front Range and surrounding areas occurred through the Miocene, Pliocene, and Pleistocene, and may continue to this day, as indicated by widespread canyon cutting (Tweto, 1980a; Scott, 1960, 1963, and 1975; Trimble, 1980).

However, the Claimed as PBI project area is tectonically stable, and modern occurrences of earthquakes magnitude 3.0 and larger have not been recorded and are likely uncommon. See Section 4.6 for seismic history. The occurrences of earthquakes in the DJ Basin are often linked to hydrocarbon development, and are associated

with the presence of wrench faults that do not extend into the project area (Figure 7). Existing Claimed as PBI were purchased and analyzed for the Claimed as PBI project area to identify fault concerns (see Section 4.3).

4.1.b Major Stratigraphic Units

The regional and local characteristics, including Claimed as PBI project zone designation, formation name, depth, and key properties of the major stratigraphic units for the Claimed as PBI project area are presented in Table 2. Claimed as PBI from which a full suite of modern logs was collected and made publicly available through the NOGCC (see Figure 10 for location). Figure 11 depicts key stratigraphic units with their corresponding geologic age and project zone designation. Structural cross sections with well logs through the Voyager Project area are illustrated in Figures 12 and 13.

Table 2. Characteristics of Zones and Formations of the Major Stratigraphic Units from Claimed as PBI Type Well Near the Planned Voyager 1 Stratigraphic Test Well

Zone	Formation	Formation Division	Depth (ft TVD)	Thickness (ft)	Porosity (%)	Permeability (mD)
Claimed as PBI	Claimed as PBI	—	Claimed a	Claime	-	-
Claimed as PBI	Claimed as PBI	Claimed as PBI	Claimed as F	Claime	Claimed as Po	Claimed as
		Claimed as PBI	Claimed as F	Claimed a	Claimed as Po	Claimed as
Claimed as PBI	Claimed as PBI	—	Claimed as F	Claimed a	Claimed as Po	Claimed as
Claimed as PBI	Claimed as PBI	Claimed as PBI	Claimed as F	Claimed a	Claimed as Po	Claimed as
		Claimed as PBI	Claimed as F	Claimed a	Claimed as Po	Claimed as F
Claimed as PBI	Claimed as PBI	—	Claimed as F	Claimed a	Claimed as Po	Claimed as
Claimed as PBI	Claimed as PBI	—	Claimed as F	Claime	Claimed as Po	Claimed as
Claimed as PBI	Claimed as PBI	Claimed as PBI	Claimed as F	Claime	Claimed as	Claimed as F
		Claimed as PBI	Claimed as F	Claime	Claimed as Po	Claimed as
		Claimed as Po	Claimed as F	Claimed a	Claimed as P	Claimed as
Claimed as PBI	Claimed as PBI	Claimed as PBI	Claimed as F	Claime	Claimed as Po	Claimed as
		Claimed as PBI	Claimed as F	Cla	Claimed as	Claimed as F
Claimed as PBI	Claimed as PBI	—	Claimed as F	Claime	Claimed as	Claimed as F
Claimed as PBI	Claimed as PBI	—	Claimed as F	Claimed a	Claimed as Po	Claimed as
	Claimed as PBI	—	Claimed as F	Claimed a	Claimed as P	Claimed as

mD = milliDarcy

Claimed as PBI

Claimed as PBI

Claimed as PBI

Claimed as PBI

Claimed as PBI

Claimed as PBI

Claimed as PBI

Claimed as PBI

Claimed as PBI

Claimed as PBI

Claimed as PBI

Claimed as PBI

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Claimed as PBI

Claimed as PBI

4.1.c Seismic Interpretation

Seismic interpretation was performed on data licensed from an existing 3D seismic survey to assess the geometry and structure of lateral and vertical containment elements for injected CO_2. Reservoir and confining units were mapped, as well as any discontinuities transecting the injection zone that could be interpreted as faults or fracture networks.

Claimed as PBI

Claimed as PBI

- Claimed as PBI
- Claimed as PBI
- Claimed as PBI
- Claimed as PBI
- Claimed as PBI
- Claimed as PBI
- Claimed as PBI
- Claimed as PBI

Seismic interpretation deliverables of relevant horizons include seismic cross sections, depth structure maps, amplitude attribute maps, seismic thickness (isochron) maps, fault and/or fracture network identification, and associated digital files for the above.

Claimed as PBI

Figure 23 shows an interpreted seismic profile across the Claimed as PBI and all key horizons within the seismic coverage for the project. This profile shows relative continuity of the reservoir and containment formations at seismic resolution scale. Claimed as PBI

Claimed as PBI

- Claimed as PBI

- Claimed as PBI
- Claimed as PBI
- Claimed as PBI
- Claimed as PBI
- Claimed as PBI
- Claimed as PBI

Depth grids generated from the seismic data were used to plot additional maps and cross sections of relevant formations throughout the AoR, as detailed in Section 4.2.

4.2 Maps and Cross Sections of the AoR

Claimed as PBI

Claimed as PBI

Claimed as PBI

Claimed as PBI

Claimed as PBI

4.3 Faults and Fractures 40 CFR 146.82(a)(3)(ii)]

As mentioned in Section 4.1.a detailing the regional geology of the basin, Claimed as PBI

4.3.a Fault Presence

Claimed as PBI

Claimed as PBI

Claimed as PBI

4.3.b *Fault Sealing Potential*

There are no interpreted faults present within the AoR; therefore, a fault seal analysis was not performed.

4.4 Injection and Confining Zone Details [40 CFR 146.82(a)(3)(iii)]

This section focuses on the details of the injection and confining zones in the vicinity of the AoR. Claimed as PBI

Table 3. Injection and Confining Zone Details within the Model Domains

Zone	Formation	Average Surface Elevation of Formation (ft relative to msl)	Average Thickness (ft)		Lithology
			Static Model	Dynamic Model	
Claimed as PBI	Claimed as PBI	Claimed as PBI	Claimed as	Claimed as	Claimed as PBI
	Claimed as PBI	Claimed as PBI	Claimed as	Claimed as	Claimed as PBI
Claimed as PBI	Claimed as PBI	Claimed as PBI	Claimed as	Claimed as	Claimed as PBI
Claimed as PBI	Claimed as PBI	Claimed as PBI	Claimed a	Claimed a	Claimed as PBI

msl = mean sea level

4.4.a *Determination of Injection and Confining Zone*

Claimed as PBI

Claimed as PBI

Claimed as PBI

Claimed as PBI

4.4.b *Injection and Confining Zone Properties*

Claimed as PBI

Table 4. Wells With Modern Logs Used to Characterize Petrophysical Porosity and Permeability Within the Static Model Domain

Claimed as PBI

DT = sonic; K = permeability; SP = spontaneous potential

Porosity and Permeability

Claimed as PBI

Table 5. Average Porosity and Permeability of the Injection and Confining Zones from Geophysical Log Analysis and Geocellular Modeling

Claimed as PBI

Claimed as PBI

Mineralogy

Claimed as PBI

Sealing Capacity and Integrity

Claimed as PBI

Claimed as PBI

Table 6. CO_2 Seal Types Assessment Based on Air-Hg Entry Pressure and Range in CO_2 Column Height Using MICP Analysis Results

Seal Type	Entry Pressure (pounds per square inch)	CO_2 Column Height (feet)
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	Claimed as PBI

Modified from Sneider et al., 1997

Storage Capacity

Claimed as PBI [redacted]

4.5 Geomechanical and Petrophysical Information [40 CFR 146.82(a)(3)(iv)]

4.5.a *Fracture Gradient Estimation*

Claimed as PBI [redacted]

Claimed as PBI

Claimed as PBI

(1a)

(1b)

Claimed as PBI

Claimed as PBI

(2)

Claimed as PBI

Claimed as PBI

Claimed as PBI

4.5.b Effective Horizontal Stress

Claimed as PBI

Claimed as PBI

4.6 Seismic History [40 CFR 146.82(a)(3)(v)]

U.S. Geological Survey (USGS) earthquake data were queried to provide historical earthquake events that have occurred between 1960 and 2024. There have been no recorded seismic events within a 25-mile radius of the Claimed as PBI Project site. No earthquakes have occurred in the sedimentary column above the granitic basement or associated with known faults in the area.

Figure 32 displays the locations of earthquakes from the USGS that occurred from 1960 to January 2024. Identified faults are shown, along with the Claimed as PBI injection well location. No significant seismicity has occurred proximally to identified faults or in the Claimed as PBI Project area.

4.7 Hydrologic and Hydrogeologic Information [40 CFR 146.82(a)(3)(vi), 146.82(a)(5)]

Regional hydrologic and hydrogeologic characteristics were compiled using resources from the Nebraska Groundwater Atlas (Korus et al., 2013) and multiple USGS and academic publications. Figure 33 illustrates a general chronostratigraphic geologic chart of the Nebraska aquifers (Korus et al., 2013).

Local geology was characterized using well logs, published water data, and analysis of data from the Claimed as PBI type well. The apparent water resistivity (RWA) method, also known as the resistivity-porosity (RP) method, was used to calculate salinity for zones where fluid was not collected. The RWA method uses Archie's equation to determine formation water resistivity to calculate salinity and has been documented as the most reliable method for estimating formation water resistivity in saturated zones (Lyle, 1988).

4.7.a Freshwater Aquifers

High Plains Aquifer – Quaternary Dunes and Ogallala Formation

Claimed as PBI

Alluvial Valley Aquifers

Claimed as PBI

Claimed as PBI

USDW Zones

Claimed as PBI

Claimed as PBI

Hydrogeology of Non-USDW Zones

Cretaceous Claimed as PBI *Carbonates*

Claimed as PBI

Cretaceous Claimed as PBI *Sandstone*

Claimed as PBI

Cretaceous Claimed as PBI *Sandstones*

Claimed as PBI

Claimed as PBI

Claimed as PBI

Claimed as PBI

Cretaceous Claimed as PBI *Sandstone*

Claimed as PBI

Claimed as PBI

Claimed as PBI

Jurassic Claimed as PBI *Sandstones*

Claimed as PBI

Claimed as PBI

Claimed as PBI

Permian Claimed as PBI

Claimed as PBI

Claimed as PBI

Claimed as PBI

Claimed as PBI

Claimed as PBI

4.7.b Water Wells within the AoR

Claimed as PBI

4.7.c Aquifer Depths

Claimed as PBI

Table 7. Depths of Aquifers at the Claimed as PBI Well

Aquifer/Formation	Depth (ft MD)	Thickness (ft)	TDS (mg/L)
Claimed as PBI	Claimed as PBI	Claimed as PBI	Claimed as PBI
Claimed as PBI	Claimed as PBI	Claimed as PBI	Claimed as PBI
Claimed as PBI	Claimed a	Claime	Claimed as PBI
Claimed as PBI	Claimed a	Claimed a	Claimed a
Claimed as PBI	Claimed a	Claimed a	Claimed a
Claimed as PBI	Claimed as P	Claime	Claimed as PBI
Claimed as PBI	Claimed as P	Claime	Claimed as PBI
Claimed as PBI	Claimed as P	Claimed a	Claimed as PBI
Claimed as PBI	Claimed as P	Claimed a	Claimed as PBI
Claimed as PBI	Claimed as P	Claime	Claimed as PBI
Claimed as PBI	Claimed as P	Claime	Claimed as PBI

4.7.d Baseline Geochemistry

Claimed as PBI

4.7.e Oil and Gas Production

Claimed as PBI

Claimed as PBI .

4.8 Geochemistry [40 CFR 146.82(a)(6)]

Claimed as PBI

- Claimed as PBI
- Claimed as PBI

4.8.a Injection Zone Fluid Geochemistry

Table 8 summarizes the fluid analysis for the injection zone.

Table 8. Comprehensive Fluid Analysis for the Injection Zone

Claimed as PBI

*Claimed as PBI

**Claimed as PBI

Claimed as PBI

4.8.b Injection Zone and Upper Confining Zone Mineralogy

Claimed as PBI

Table 9. Average Mineralogy of the Injection Zone and Upper Confining Zone

Claimed as PBI

4.8.c Injectate Chemistry

Claimed as PBI

4.8.d Equilibrium Geochemical Modeling

PHREEQC, developed by USGS, is a robust geochemical program that enables the simulation of complex

Claimed as PBI

Geochemical Database

Claimed as PBI

- Claimed as PBI

- Claimed as PBI
- Claimed as PBI
- Claimed as PBI
- Claimed as PBI
- Claimed as PBI

Saturation Indices

Claimed as PBI

Claimed as PBI (3)

Claimed as PBI

Claimed as PBI

- Claimed as PBI
- Claimed as PBI
- Claimed as PBI

Claimed as PBI

Geochemical Model Input

Claimed as PBI

Claimed as PBI

Claimed as PBI

Claimed as PBI

.

Table 10. Mineral Molar Ratios for the Claimed as PBI

Claimed as PBI

Claimed as PBI

Geochemical Modeling Results and Discussion

Claimed as PBI

Table 11. PHREEQC Equilibrium Model Results

Claimed as PBI

Claimed as PBI

- Claimed as PBI
- Claimed as PBI
- Claimed as PBI

Claimed as PBI

Claimed as PBI

Claimed as PBI

- Claimed as PBI
- Claimed as PBI
- Claimed as PBI

Claimed as PBI

4.9 Site Suitability [40 CFR 146.83]

The proposed Claimed as PBI project site is suitable for the injection and containment of CO_2 as demonstrated in the sections above. Responses to recommended EPA questions are given below.

What is the subsurface distribution of lithological facies? What are the implications for carbon dioxide plume migration?

Claimed as PBI

Claimed as PBI

How will carbon dioxide be confined to the injection zone? How do the site characterization data demonstrate the lack of potential leakage pathways?

Claimed as PBI

Claimed as PBI

Claimed as PBI

Claimed as PBI

Claimed as PBI

Claimed as PBI

How will the carbon dioxide stream interact with well materials and subsurface formations (injection and confining zones)?

Claimed as PBI

Claimed as PBI

Claimed as PBI

What is the total storage capacity of the injection zone? How was this determined? How is this sufficient to receive the proposed amount of carbon dioxide?

Claimed as PBI

Claimed as PBI

Claimed as PBI

Claimed as PBI

Claimed as PBI

Are there any potential concerns regarding confining zone integrity? What site characterization data support this determination?

Claimed as PBI

5. AoR and Corrective Action

The Claimed as PBI Project AoR and Corrective Action Plan is provided as **Attachment A: AoR and Corrective Action Plan**. This attachment has been developed in compliance with 40 CFR §146.84, area of review and corrective action, which requires that the owner or operator of a Class VI well prepare, maintain, and comply with a plan to delineate the area of review for a proposed geologic sequestration project, as well as periodically reevaluate the delineation and perform corrective action if necessary. **Attachment A: AoR and Corrective Action Plan** has been submitted to the GSDT as follows:

AoR and Corrective Action GSDT Submissions

GSDT Module: AoR and Corrective Action

Tab(s): All applicable tabs

Please use the checkbox(es) to verify the following information was submitted to the GSDT:

☒ Tabulation of all wells within AoR that penetrate confining zone ***[40 CFR 146.82(a)(4)]***

☒ AoR and Corrective Action Plan ***[40 CFR 146.82(a)(13) and 146.84(b)]***

☒ Computational modeling details ***[40 CFR 146.84(c)]***

6. Injection Well Construction

The Claimed as PBI Project will construct the Claimed as PBI well as a Class VI injection well for CO_2 sequestration. Construction details are provided in **Attachment B: Construction Details**, which includes information about construction procedures, casing and cement, tubing and packer, and continuous monitoring. The injection well construction details have been developed in compliance with 40 CFR 146.86, injection well construction requirements. **Attachment B: Construction Details** has been submitted to the GSDT as follows:

Injection Well Construction GSDT Submissions

GSDT Module: Project Information Tracking

Tab(s): Initial Permit Application

Please use the checkbox(es) to verify the following information was submitted to the GSDT:

☒ Injection Well Construction Requirements ***[40 CFR 146.86]***

7. Proposed Stimulation Program

A Stimulation Plan has been developed for the Claimed as PBI Project in compliance with 40 CFR 146.82(a)(9), and is provided as **Attachment C: Stimulation Plan**. Claimed as PBI Stimulation Plan describes methods and procedures for stimulation, Claimed as PBI . Compatibility of the stimulation fluids with the injection and confining zones will be demonstrated if Claimed as PBI . **Attachment C: Stimulation Plan** has been submitted to the GSDT as follows:

Stimulation Plan GSDT Submissions
GSDT Module: Project Information Tracking ***Tab(s):*** Initial Permit Application Please use the checkbox(es) to verify the following information was submitted to the GSDT: ☒ Proposed stimulation program ***[40 CFR 146.82(a)(9)]***

8. Pre-Operational Logging and Testing

A Pre-Operational Testing Program has been developed in compliance with 40 CFR 146.87, logging, sampling, and testing prior to injection well operation, and is provided as **Attachment D: Pre-Operational Testing Plan**. The Pre-Operational Testing Program describes deviation checks, tests and logs that will be performed during the drilling of Claimed as PBI and the tests and logs to be performed during tubing and packer installation. Additionally, pre-operational tests and logs to be performed in the Claimed as PBI monitoring well are discussed in this plan. **Attachment D: Pre-Operational Testing Plan** has been submitted to the GSDT as follows:

Pre-Operational Logging and Testing GSDT Submissions
GSDT Module: Pre-Operational Testing ***Tab(s):*** Welcome tab Please use the checkbox(es) to verify the following information was submitted to the GSDT: ☒ Proposed pre-operational testing program ***[40 CFR 146.82(a)(8) and 146.87]***

9. Well Operation

The Claimed as PBI Project well operations are described in **Attachment E: Operating and Reporting Conditions**. Attachment E includes information that fulfills requirements for this Class VI permit application listed at 40 CFR 146.82(a)(7) and (10) and 40 CFR 146.88, injection well operating requirements. This includes

proposed operating data such as average and maximum daily rate and volume and/or mass, total anticipated volume and/or mass, average and maximum injection pressure, source of the CO_2 stream, and an analysis of the chemical and physical characteristics of the CO_2 stream. It also describes overall operational procedures, routine shutdown procedures, and reporting requirements. **Attachment E: Operating and Reporting Conditions** has been submitted to the GSDT as follows:

Operating and Reporting Conditions GSDT Submissions
GSDT Module: Project Information Tracking ***Tab(s):*** Initial Permit Application Please use the checkbox(es) to verify the following information was submitted to the GSDT: ☒ Proposed operating data ***[40 CFR 146.82(a)(7)]*** ☒ Proposed injection procedure ***[40 CFR 146.82(a)(10)]*** ☒ Injection well operating requirements ***[40 CFR 146.88]***

10. Testing and Monitoring

A Testing and Monitoring Plan prepared pursuant to 40 CFR 146.90, testing and monitoring requirements, is provided as **Attachment F: Testing and Monitoring Plan**. The Testing and Monitoring Plan will be used for ongoing project monitoring to verify that the CCS project is operating as permitted and is not endangering USDWs. Additionally, a Quality Assurance and Surveillance Plan (QASP) prepared pursuant to 40 CFR 146.90(k) is included as **Attachment G: QASP**. **Attachment F: Testing and Monitoring Plan** and **Attachment G: QASP** have been submitted to the GSDT as follows:

Testing and Monitoring GSDT Submissions
GSDT Module: Project Plan Submissions ***Tab(s):*** Testing and Monitoring tab Please use the checkbox(es) to verify the following information was submitted to the GSDT: ☒ Testing and Monitoring Plan [40 CFR 146.82(a)(15) and 146.90]

11. Injection Well Plugging

The Claimed as PBI Project Injection Well Plugging Plan is provided as **Attachment H: Injection Well Plugging Plan**, and has been prepared pursuant to 40 CFR 146.92(b), well plugging plan. The Injection Well Plugging Plan includes appropriate tests or measures for determining bottomhole reservoir pressure and ensuring external mechanical integrity, the type, number, placement, and method of placement of plugs, and the type,

grade, and quantity of material to be used in plugging that is compatible with the CO_2 stream. **Attachment H: Injection Well Plugging Plan** has been submitted to the GSDT as follows:

Injection Well Plugging GSDT Submissions
GSDT Module: Project Plan Submissions ***Tab(s):*** Injection Well Plugging tab Please use the checkbox(es) to verify the following information was submitted to the GSDT: ☒ Injection Well Plugging Plan [40 CFR 146.82(a)(16) and 146.92(b)]

12. Post-Injection Site Care (PISC) and Site Closure

The Claimed as PBI Project PISC and Site Closure Plan is provided as **Attachment I: PISC and Site Closure Plan**, and has been prepared pursuant to 40 CFR 146.93, post-injection site care and site closure. Claimed as PBI . **Attachment I: PISC and Site Closure Plan** has been submitted to the GSDT as follows:

PISC and Site Closure GSDT Submissions
GSDT Module: Project Plan Submissions ***Tab(s):*** PISC and Site Closure tab Please use the checkbox(es) to verify the following information was submitted to the GSDT: ☒ PISC and Site Closure Plan [40 CFR 146.82(a)(17) and 146.93(a)]
GSDT Module: Claimed as PBI ***Tab(s):*** Claimed as PBI Please use the checkbox(es) to verify the following information was submitted to the GSDT: ☒ Claimed as PBI

13. Emergency and Remedial Response

The Claimed as PBI Project Emergency and Remedial Response Plan (ERRP) is provided as **Attachment J: ERRP** and has been prepared in accordance with 40 CFR 146.94, emergency and remedial response. The ERRP describes actions that the owner or operator must take to address movement of the injection or formation

fluids that may cause an endangerment to a USDW during construction, operation, and post-injection site care based on potential risk scenarios. **Attachment J: ERRP** has been submitted to the GSDT as follows:

Emergency and Remedial Response GSDT Submissions
GSDT Module: Project Plan Submissions ***Tab(s):*** Emergency and Remedial Response tab Please use the checkbox(es) to verify the following information was submitted to the GSDT: ☒ Emergency and Remedial Response Plan *[40 CFR 146.82(a)(19) and 146.94(a)]*

14. Financial Responsibility

The Claimed as PBI Project Financial Assurance Demonstration is provided as **Attachment K: Financial Assurance Demonstration** and has been prepared in accordance with 40 CFR 146.85, financial responsibility. This attachment describes the qualifying financial instrument(s) applicable to the proposed project that are sufficient to cover the cost of corrective action, injection well plugging, post-injection site care and site closure, and emergency and remedial response, as well as potential endangerment of USDWs. **Attachment K: Financial Assurance Demonstration** has been submitted to the GSDT as follows:

Financial Responsibility GSDT Submissions
GSDT Module: Financial Responsibility Demonstration ***Tab(s):*** Cost Estimate tab and all applicable financial instrument tabs Please use the checkbox(es) to verify the following information was submitted to the GSDT: ☒ Demonstration of financial responsibility ***[40 CFR 146.82(a)(14) and 146.85]***

15. Optional Additional Project Information

This section summarizes additional project information based on 40 CFR 144.4, considerations under federal law, which lists the following laws that must be considered if applicable:

- Wild and Scenic Rivers Act
- National Historic Preservation Act
- Endangered Species Act
- Coastal Zone Management Act
- Fish and Wildlife Coordination Act

- Executive orders including the Clean Water Act, Safe Drinking Water Act, Clean Air Act, and the Resource Conservation and Recovery Act

The Coastal Zone Management Act does not apply due to the Claimed as PBI project's inland location. The analysis area is dominated by rangeland vegetation, cropland, and energy development. Claimed as PBI performed a natural and cultural resources desktop review which included a 500-foot buffer around the project, and a raptor survey area that included a 0.5-mile buffer for raptor nests. The purpose of this desktop review was to identify any significant natural resource or cultural resource constraints or risks associated with the proposed development. Potential wetlands were identified in the pipeline area as well as a potentially jurisdictional water body, the Claimed as PBI Claimed as PBI has contracted a consultant to evaluate the road and pipeline canal crossings. Meetings with the canal owner have been amicable and they were receptive to the project. Grassland, wetlands, and some open water areas within 0.5 mile of the project could provide suitable habitat for two state-listed species of concern, including foraging and den habitat for swift fox (*Vulpes velox*), and foraging habitat for whooping crane (*Grus americana*), as well as other migratory bird species. NDEE is requiring a biological survey shortly before dirt work commences.

There are currently no known historic resources within the AoR subject to the National Historic Preservation Act; however, Claimed as PBI met with the State Historic Preservation Office as a precaution due to nearby historical trails of the west. During the virtual meeting, the state archaeologist performed a desktop study for cultural resources in the area using the State's proprietary lidar data. No known areas of historical significance were identified in the area, though there is a lack of survey data locally. Claimed as PBI offered to provide any archeological survey data to the state as a courtesy and will prepare an Inadvertent Discovery Plan (IDP) to provide instructions for on-site project staff in the event of an unexpected discovery of human remains or historic or prehistoric resources.

Claimed as PBI also contracted Stantec to complete a Phase I ESA of the stratigraphic well pad area in June 2023, and a subsequent Phase II ESA soil sampling event in November 2023. The results of the soil sampling at the proposed stratigraphic test well pad suggest a historical release of crude oil and condensate from the site's former use as a crude petroleum and natural gas production facility. Claimed as PBI has partnered with the NOGCC who is using federal orphan well remediation funding to remediate the site prior to the drilling of the Claimed as PBI stratigraphic test well.

Should any of these resources be identified, Claimed as PBI has flexibility to reroute. Results of the surveys can be provided to EPA upon request.

15.1 National Historic Preservation Act

The National Historic Preservation Act of 1966, 16 U.S.C. 470 et seq. Identify properties listed or eligible for listing in the National Register of Historic Places that may be affected by the activities associated with the proposed project. If previous historic and cultural resource survey(s) have been conducted, provide the results of the survey(s).

An environmental and cultural resource survey will be conducted during pipeline construction. Results of the survey will be provided to EPA.

15.2 Wild and Scenic Rivers Act

The Wild and Scenic Rivers Act, 16 U.S.C. 1273 et seq. Identify any national wild and scenic river that may be impacted by the activities associated with the proposed project.

There are no national wild and scenic rivers that will be impacted by the proposed Claimed as PBI Project.

15.3 Endangered Species Act

The Endangered Species Act, 16 U.S.C. 1531 et seq. Identify any endangered or threatened species that may be affected by the activities associated with the proposed project. If a previous endangered or threatened species survey has been conducted, provide the results of the survey.

An environmental and cultural resource survey will be conducted during pipeline construction. Results of the survey will be provided to EPA.

15.4 Fish and Wildlife Coordination Act

An environmental and cultural resource survey will be conducted during pipeline construction. Results of the survey will be provided to EPA.

16. References

Claimed as PBI .

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Figures

Figure 1

Figure 2

Figure 3

Figure 4

Figure 5

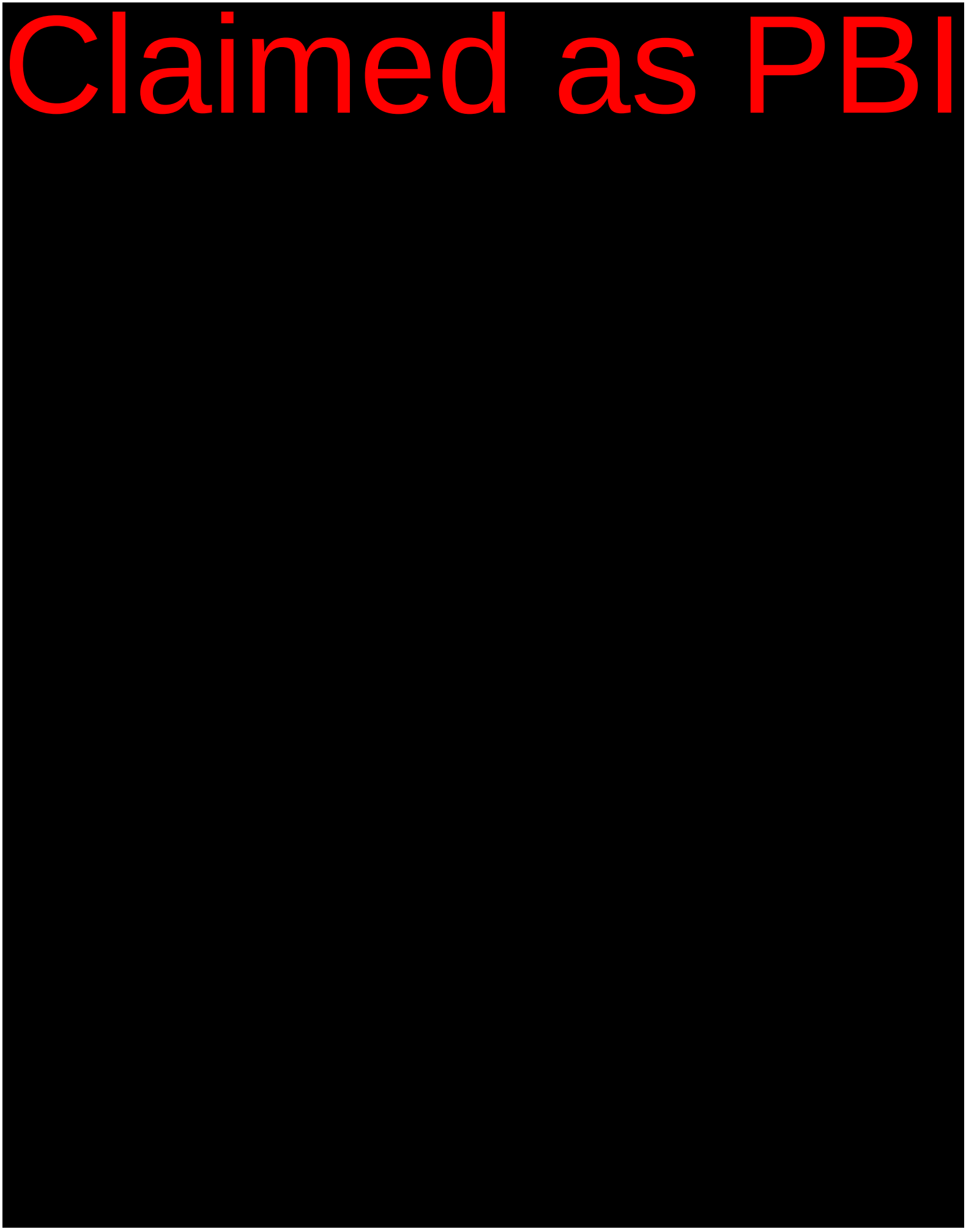

Figure 6

Figure 7

Figure 8

Figure 9

Figure 10

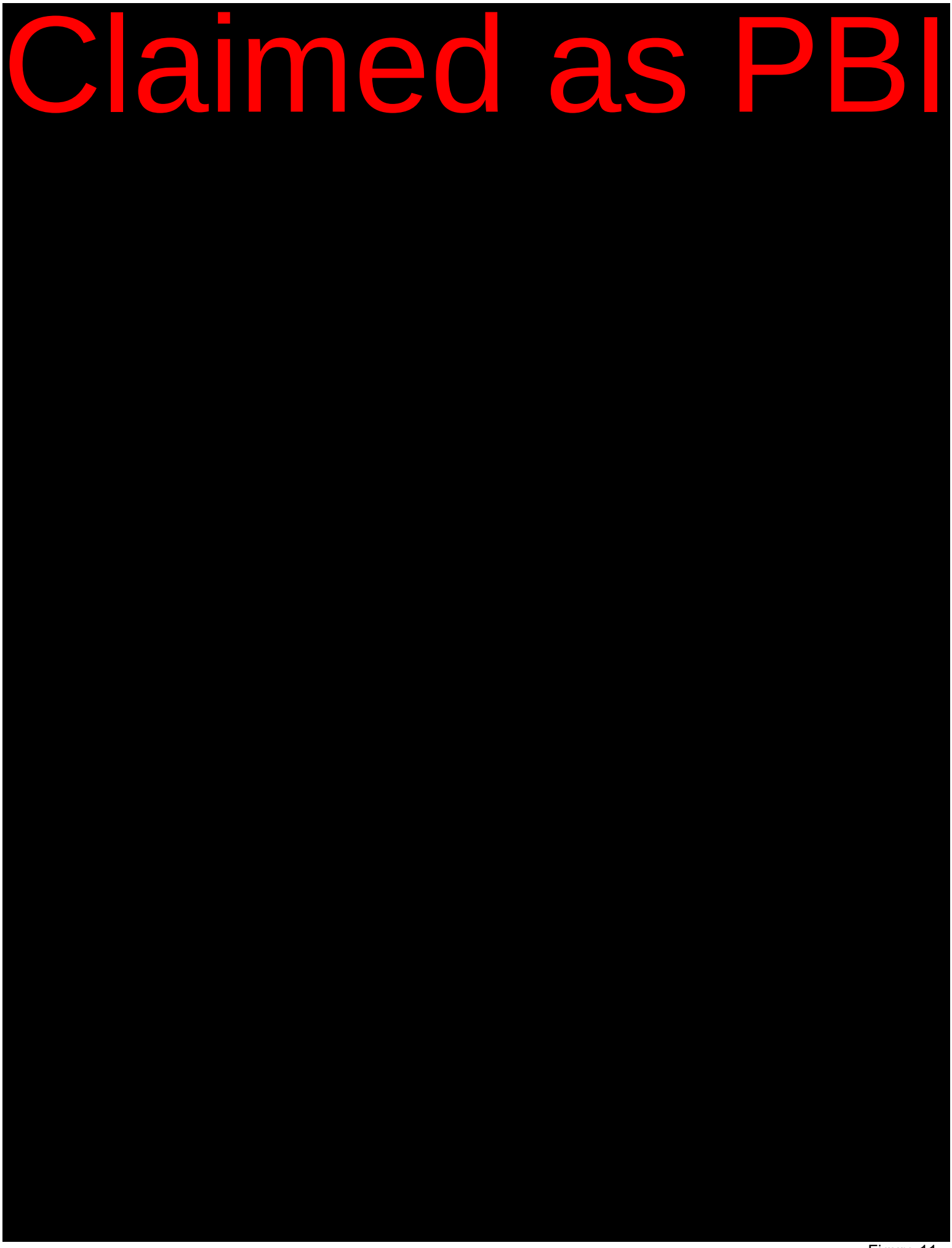

Figure 11

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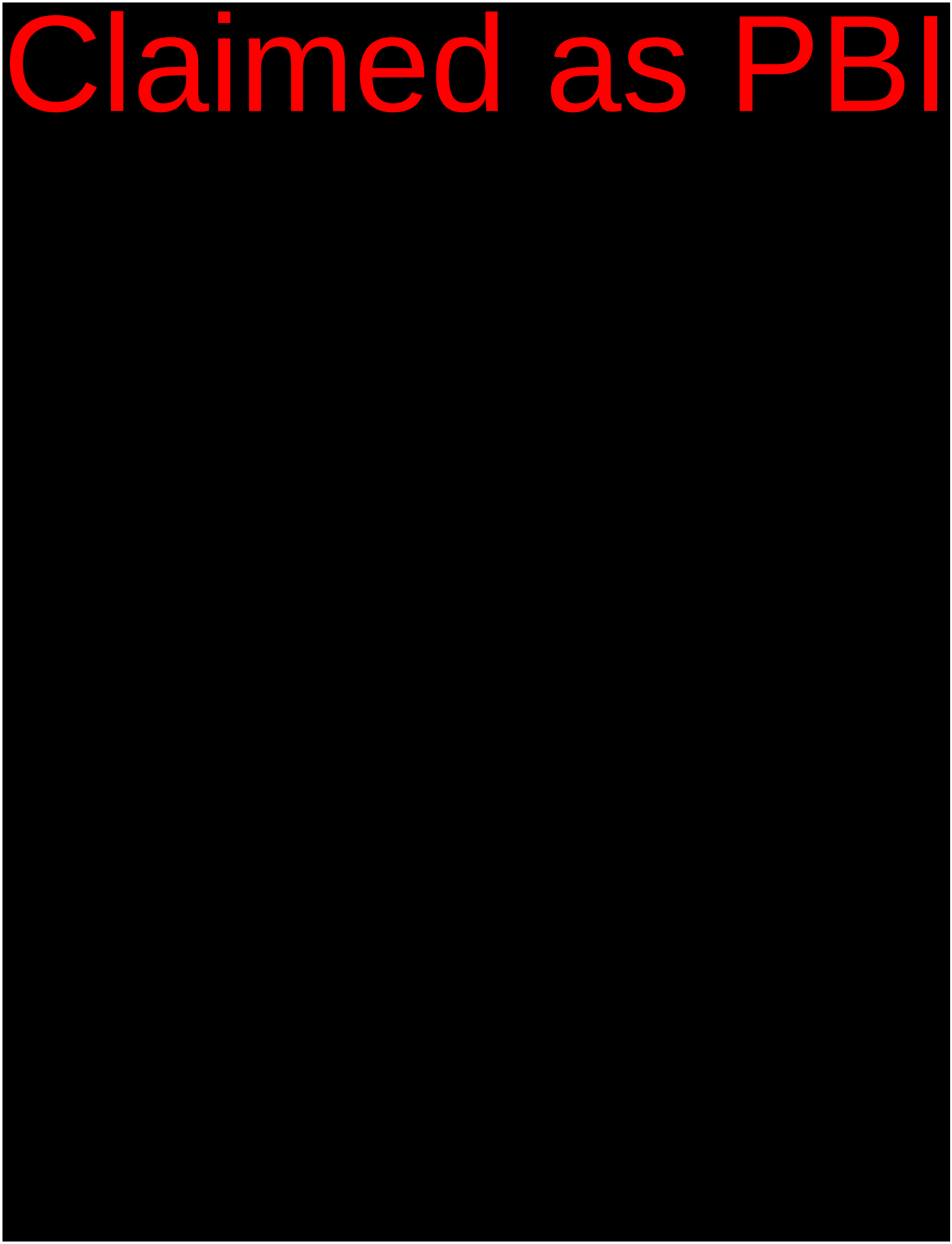

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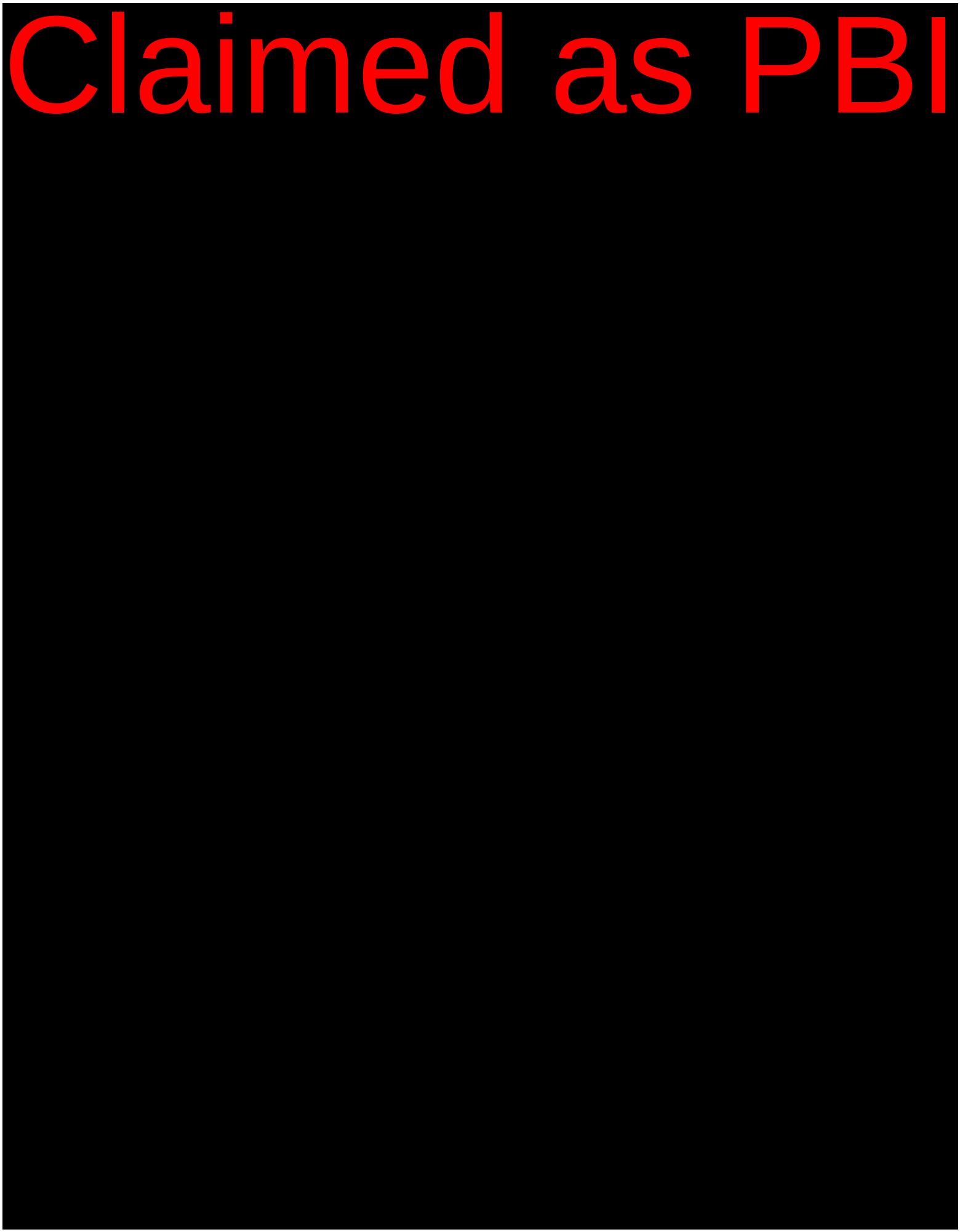

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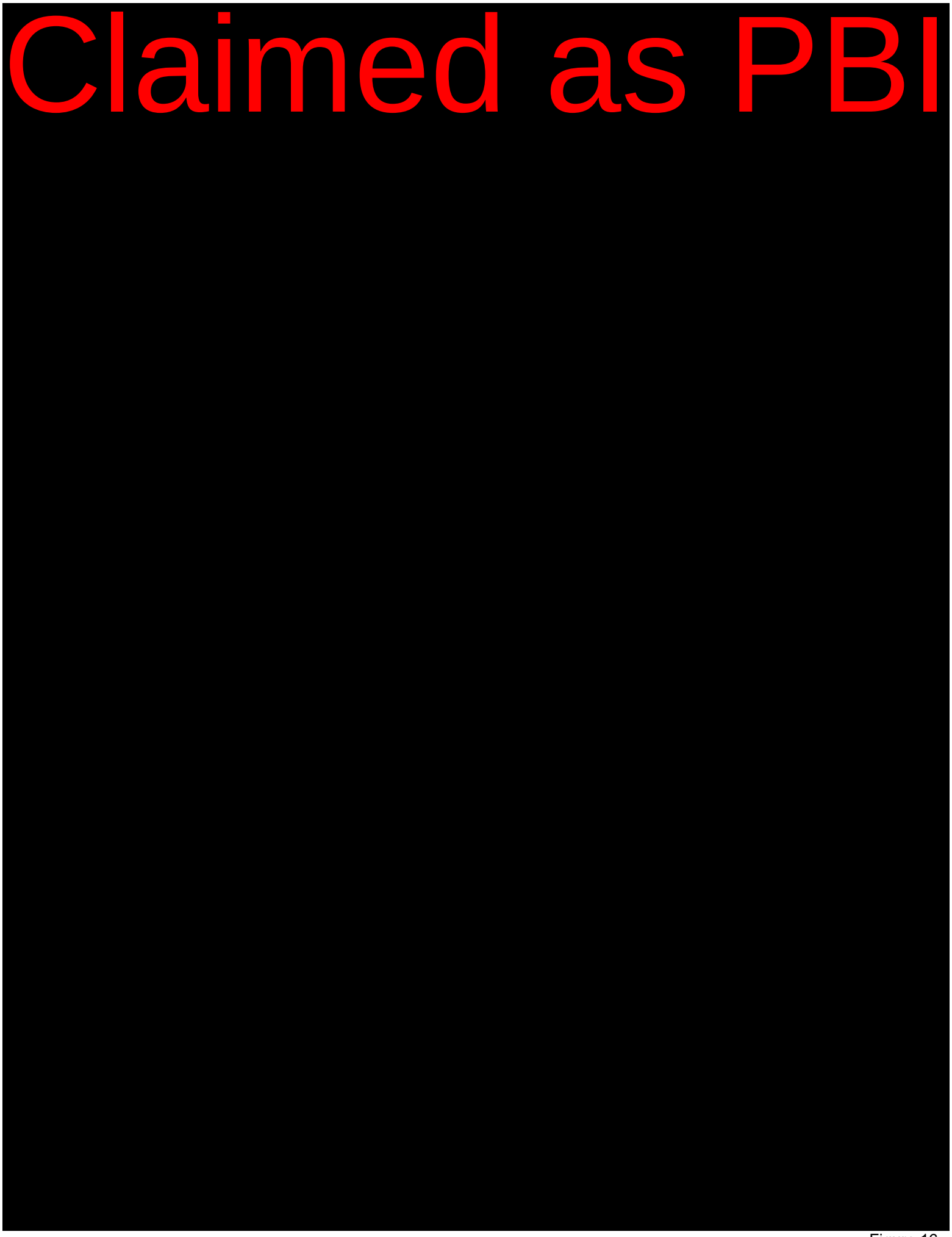

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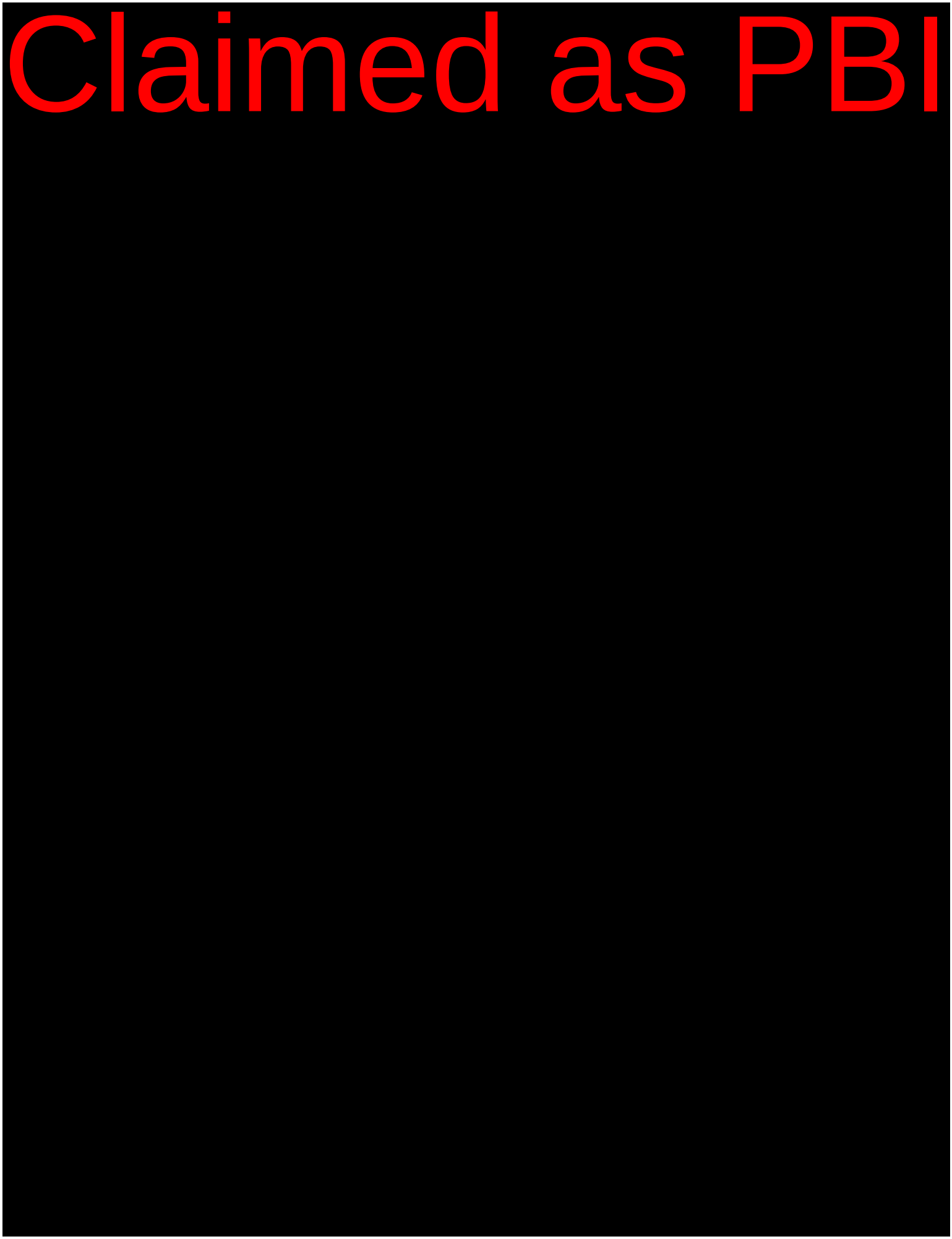

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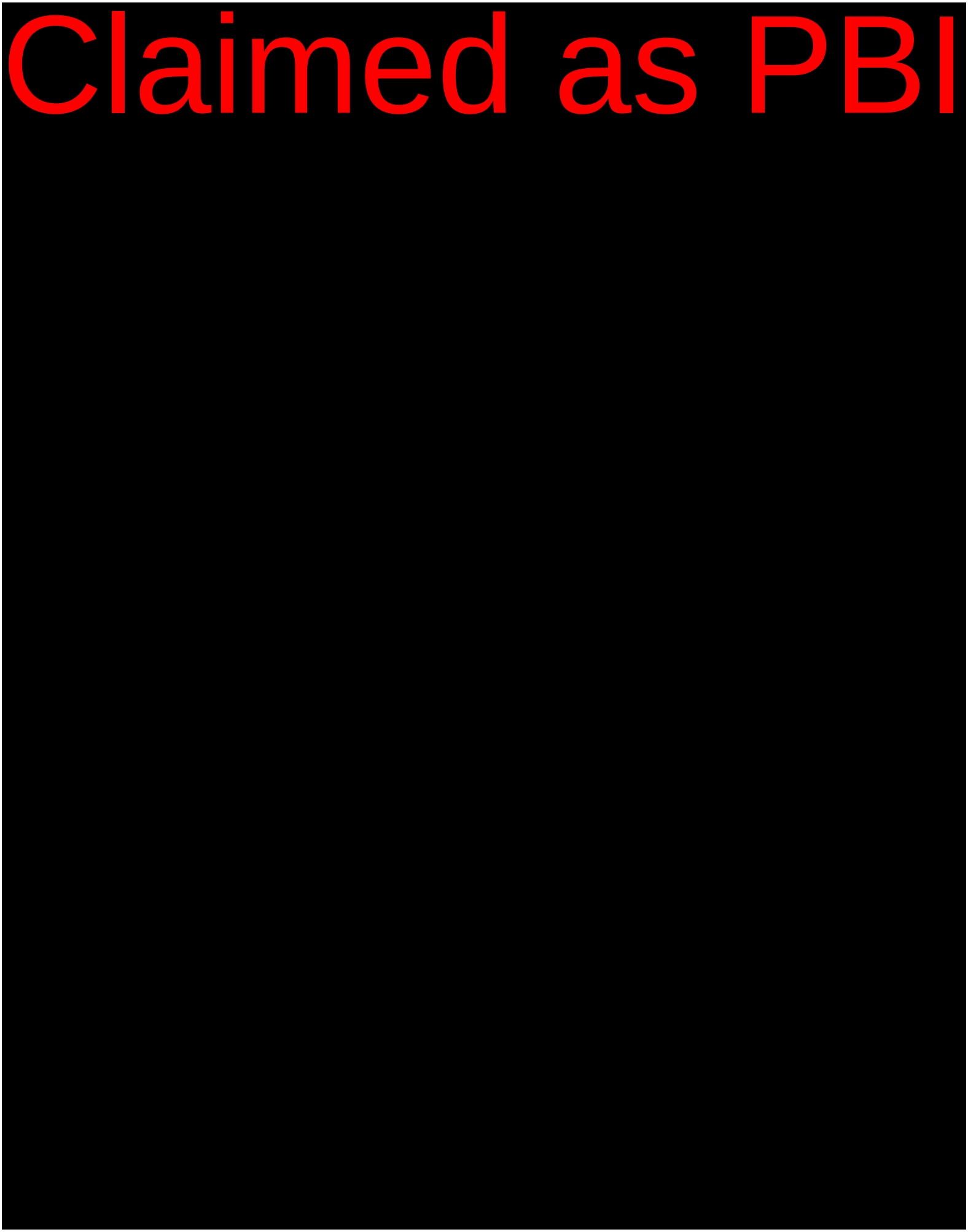

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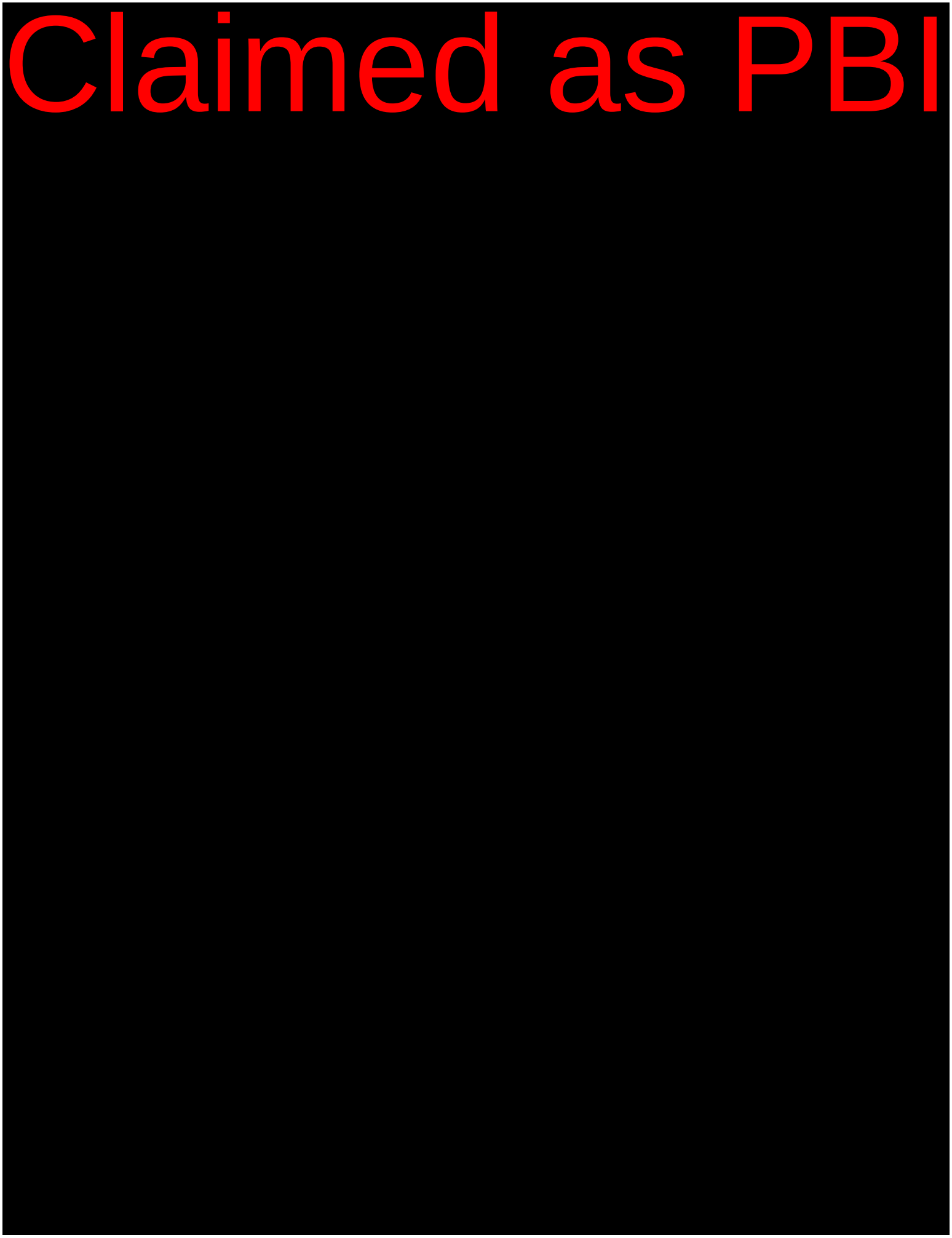

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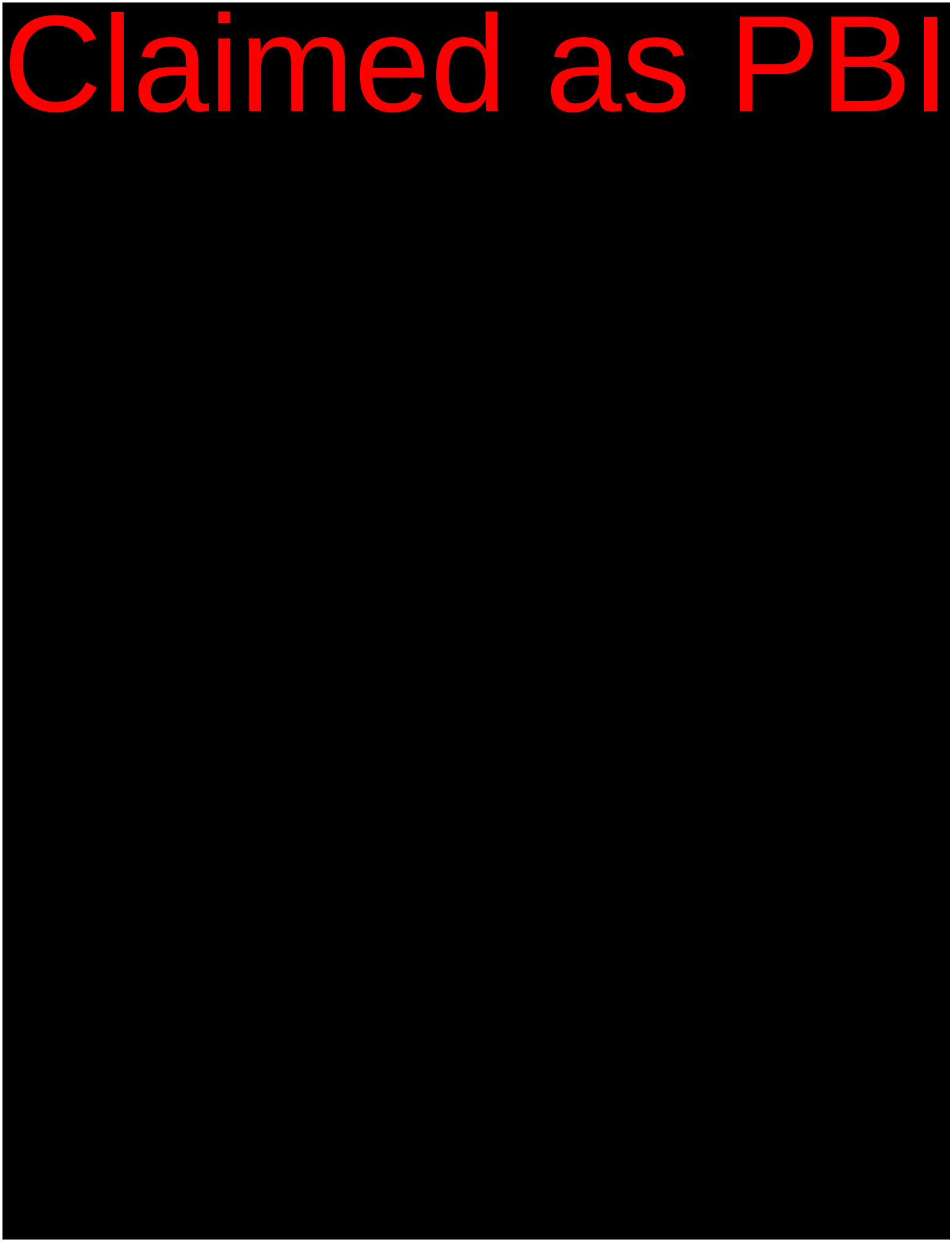

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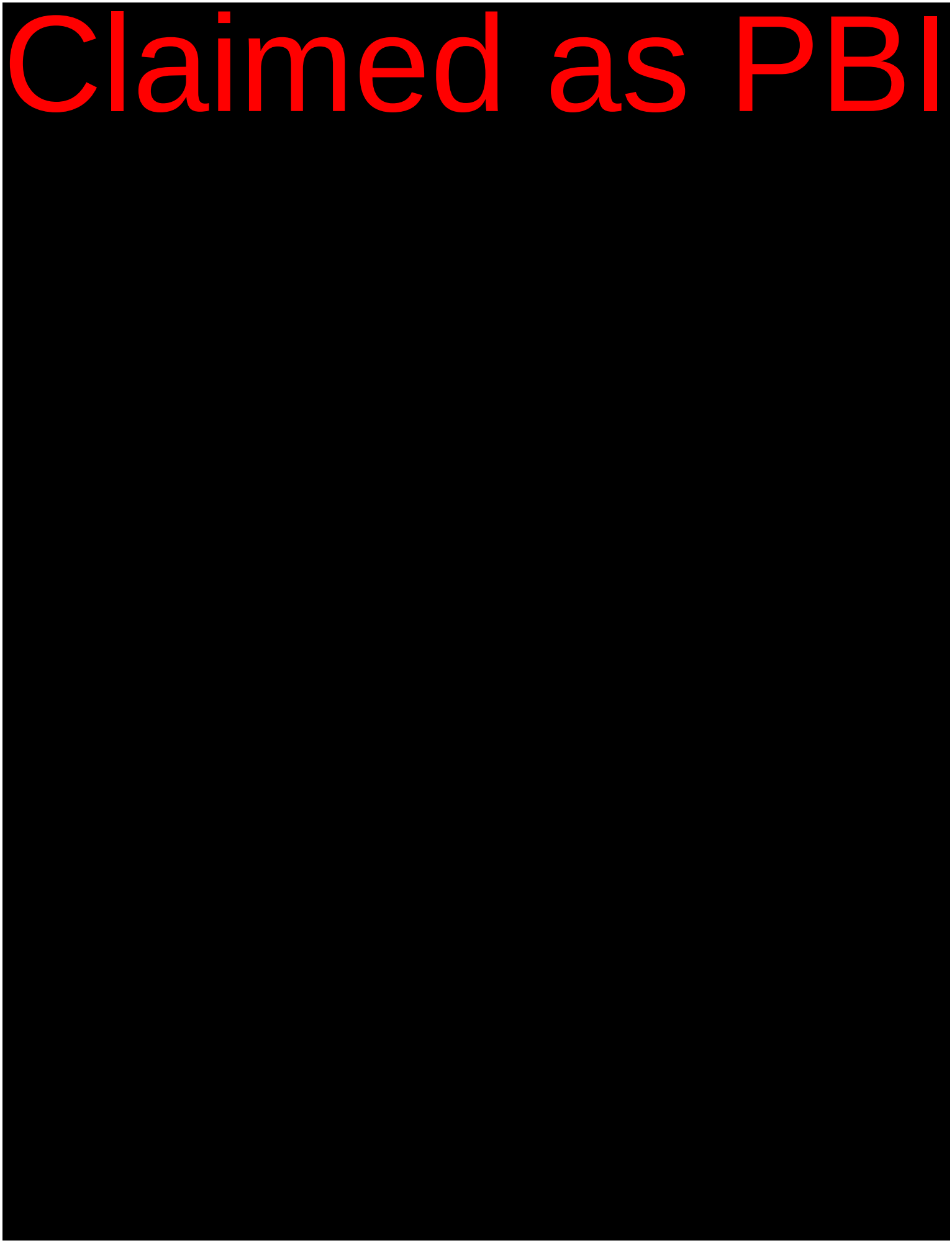

Figure 25

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Claimed as PBI

Figure 39

Figure 40

Figure 41

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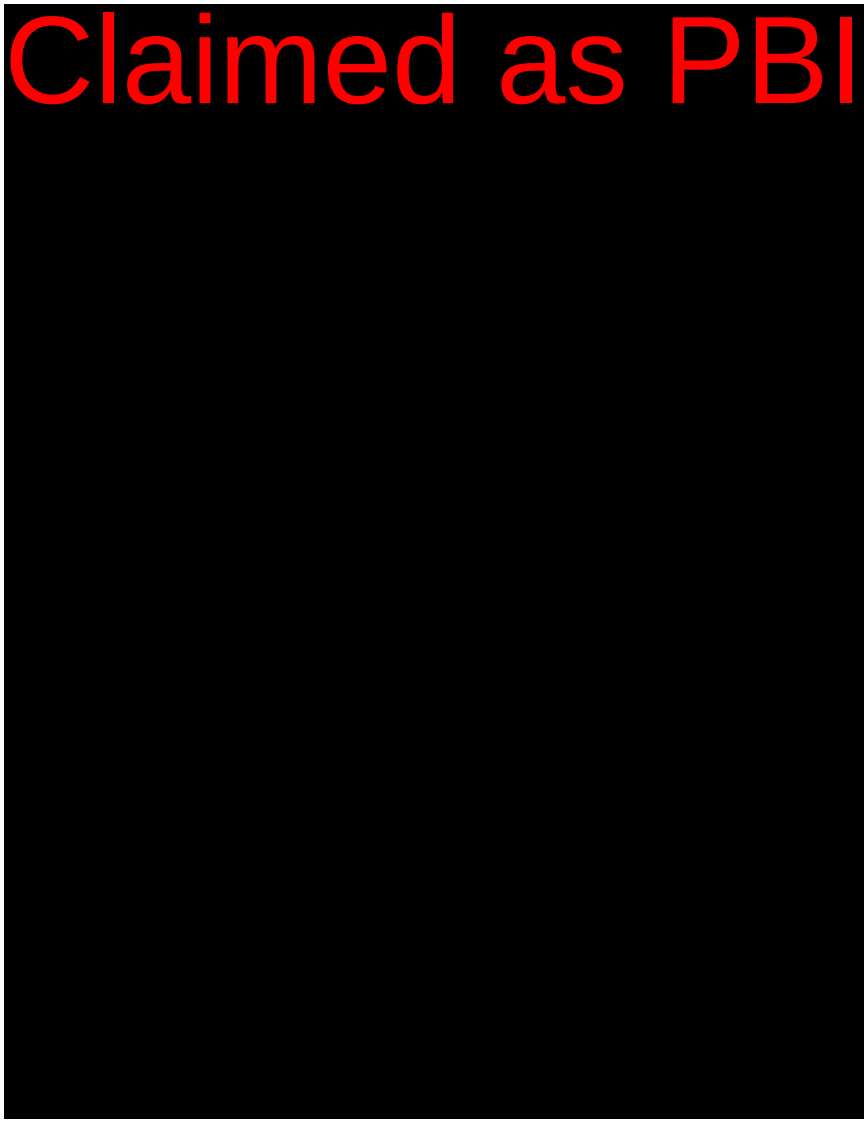
Figure 45

Appendix 1
Site Plans for Capture Facilities

Claimed as PBI

Appendix 2
Injectate Composition

Claimed as PBI
[redacted]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Appendix 3

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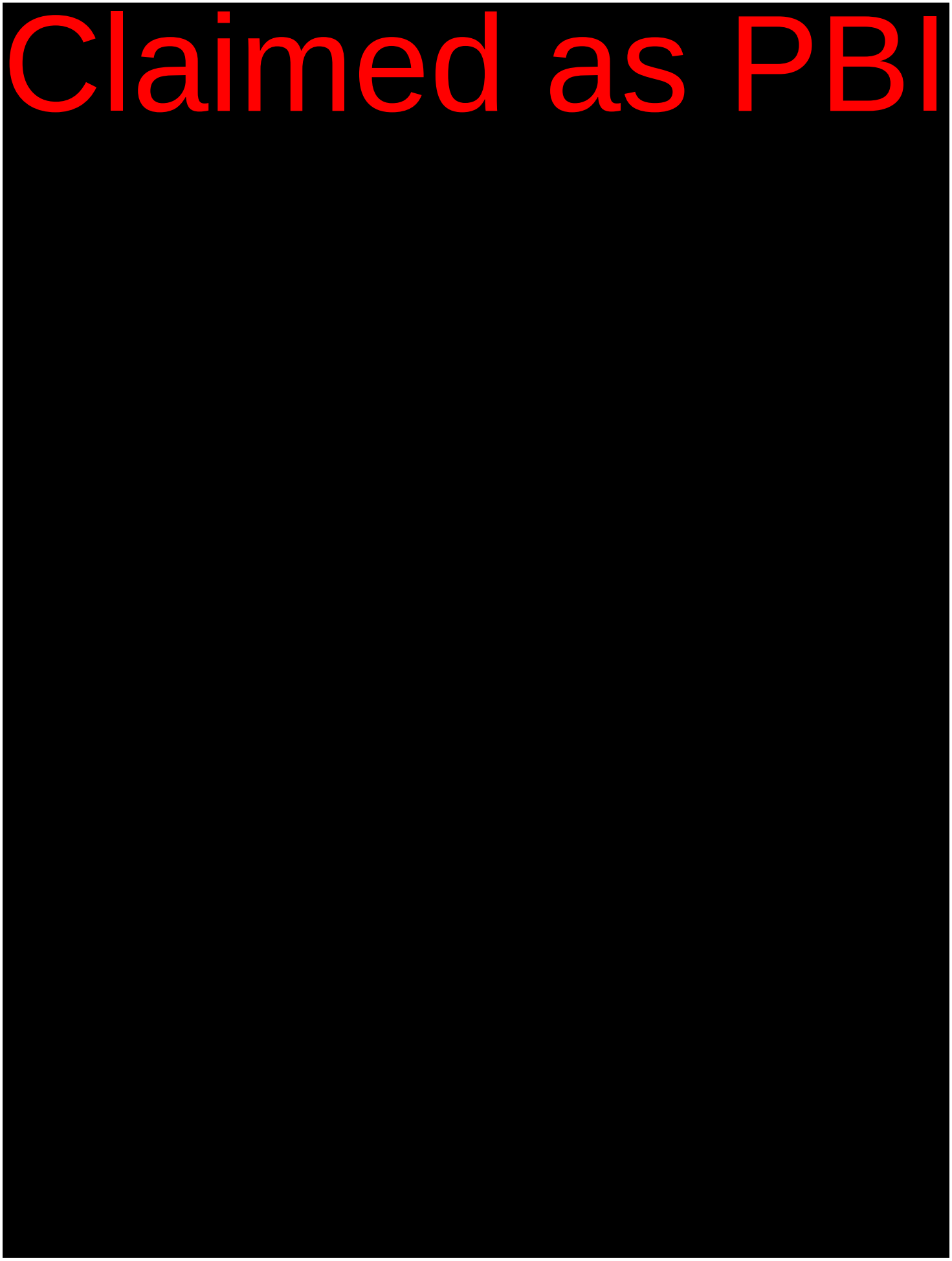
Claimed as PBI


Claimed as PBI

Appendix 4
Baseline Geochemistry Data

Claimed as PBI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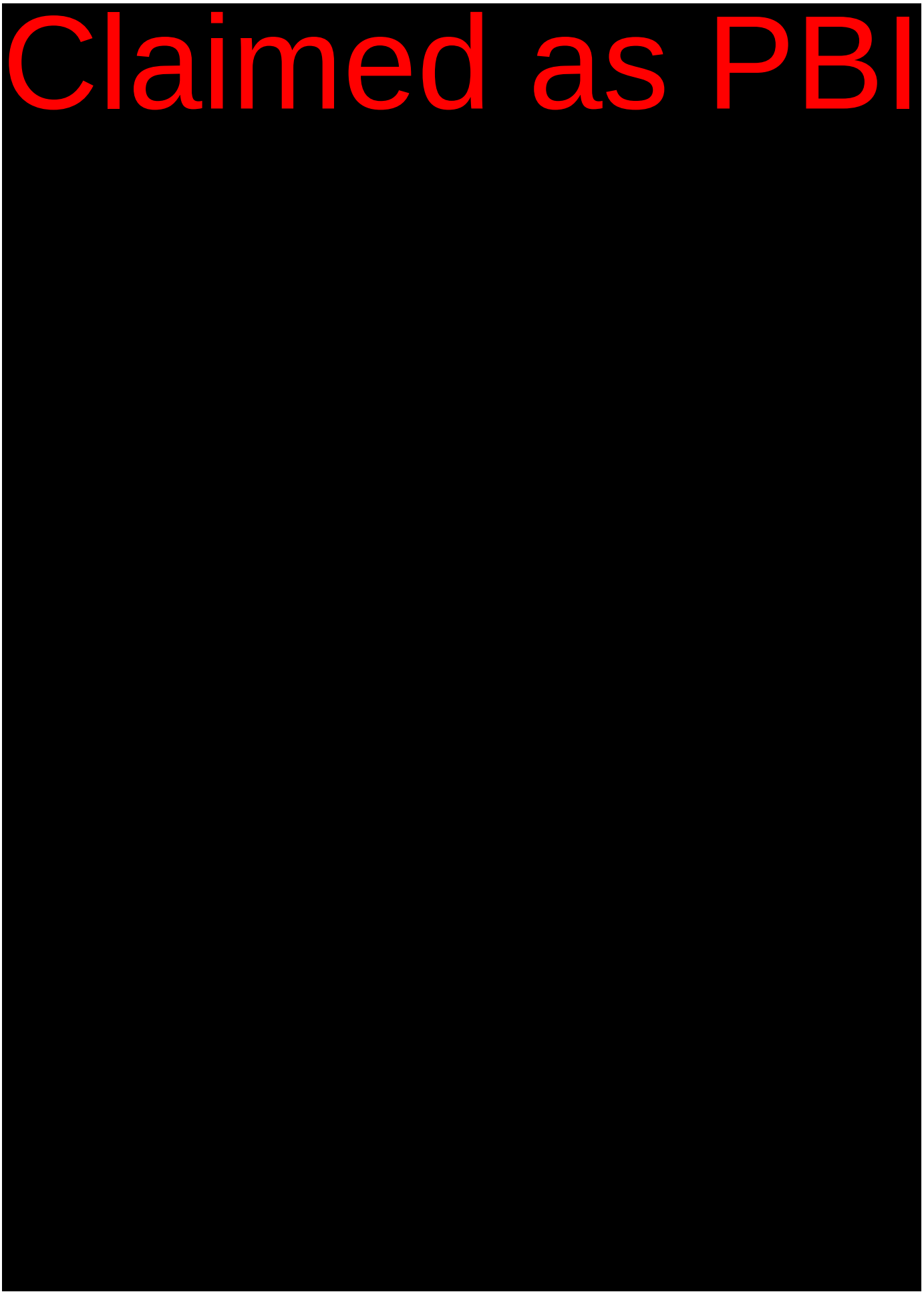
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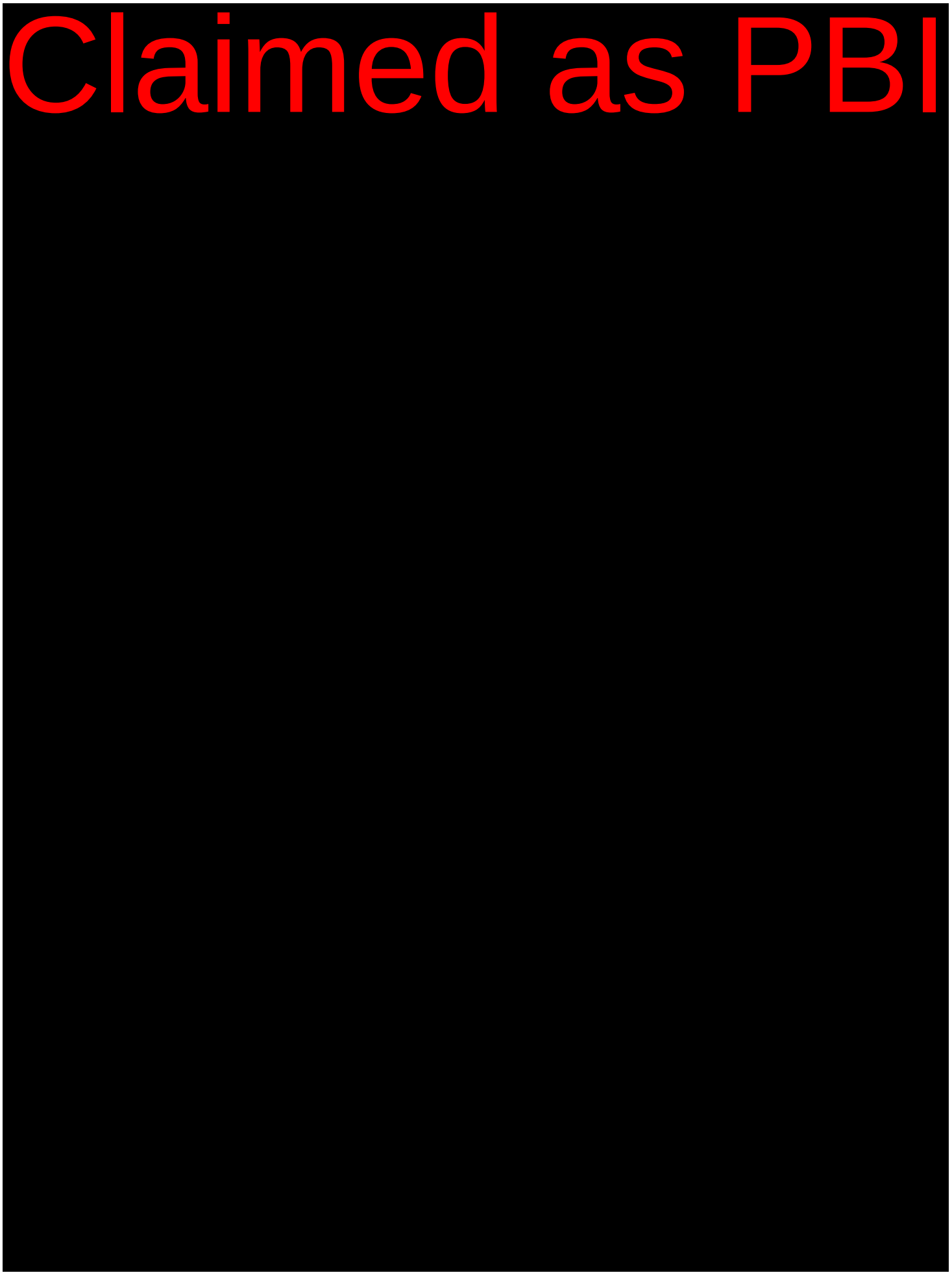
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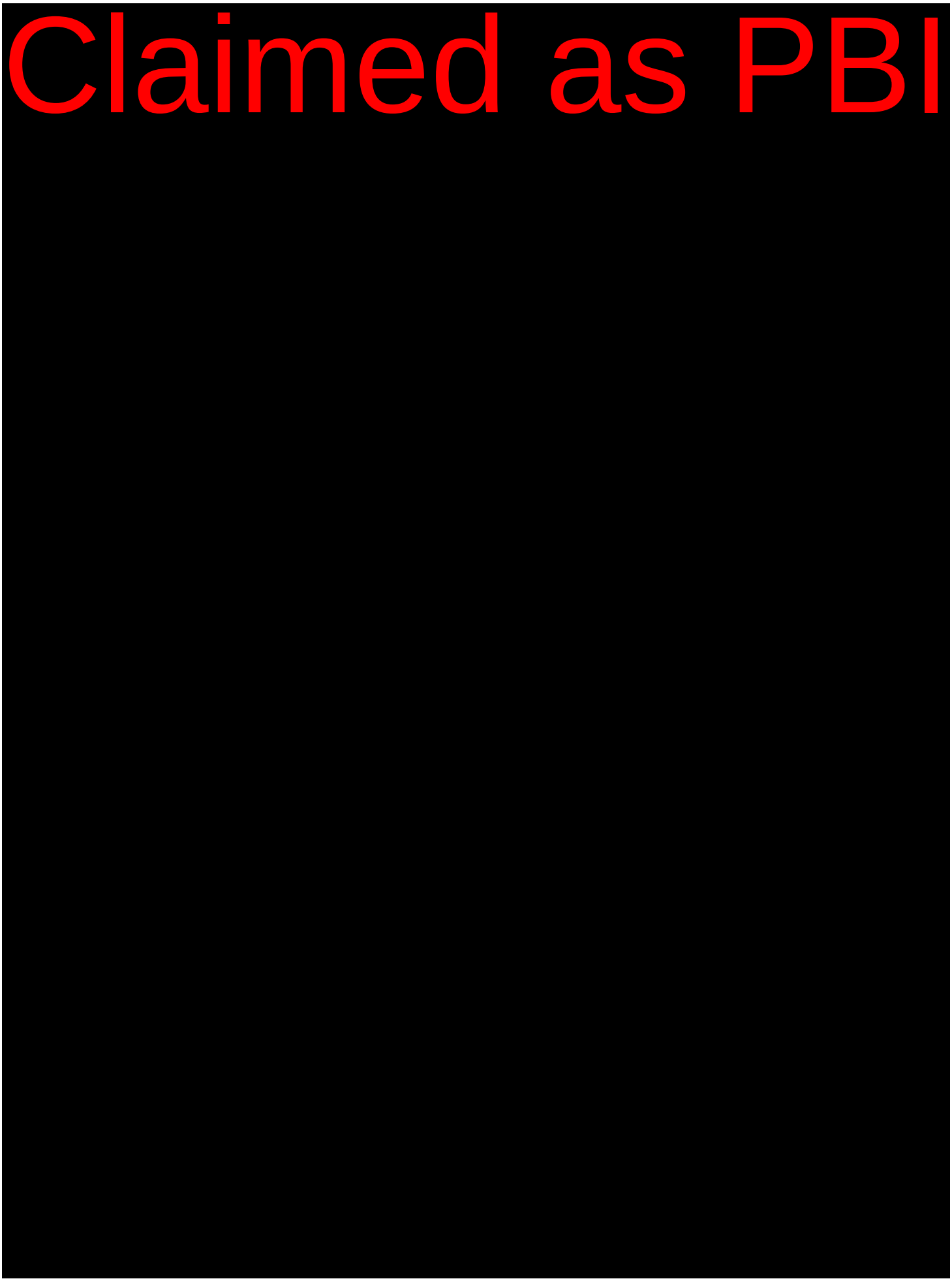
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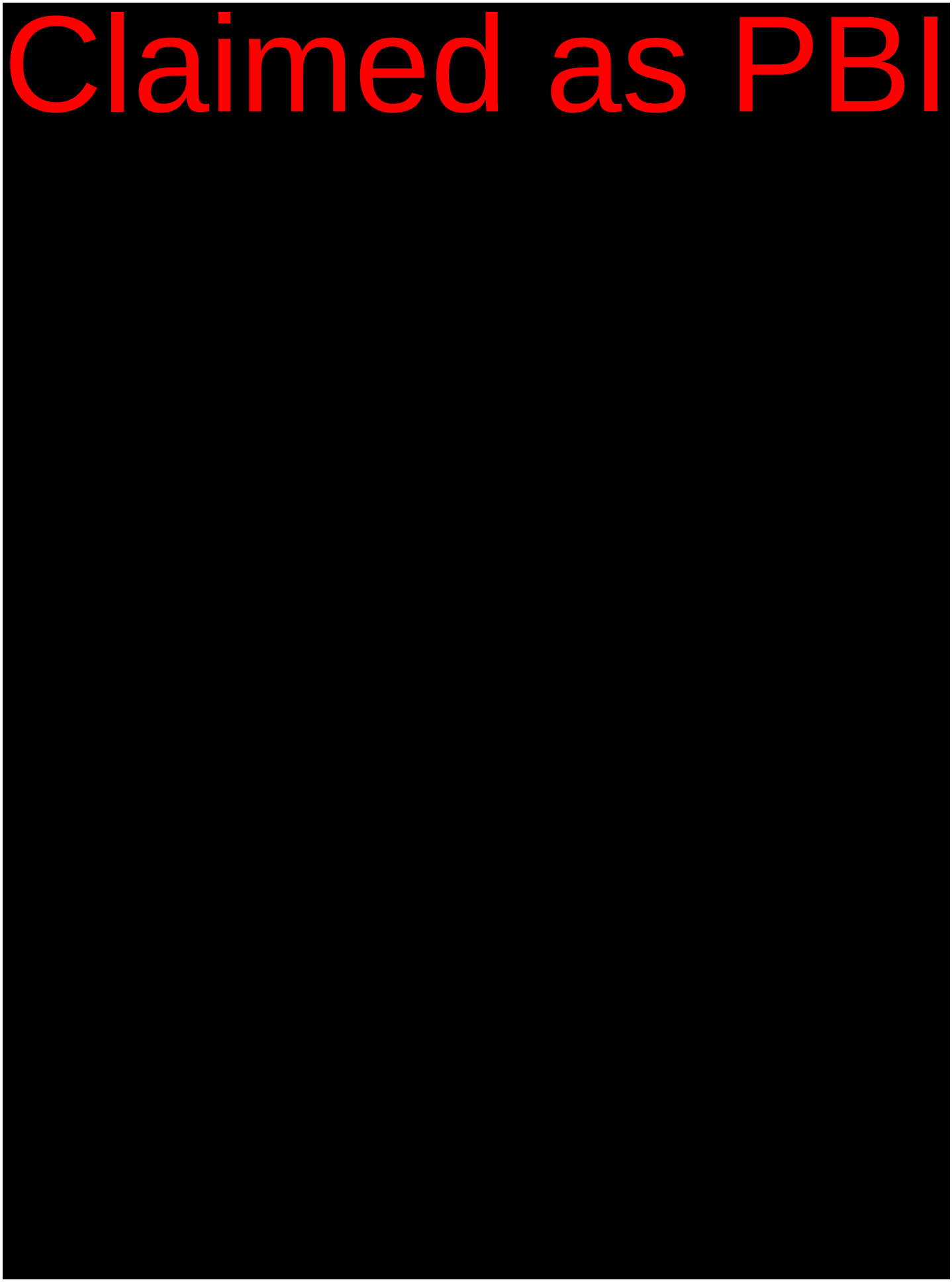
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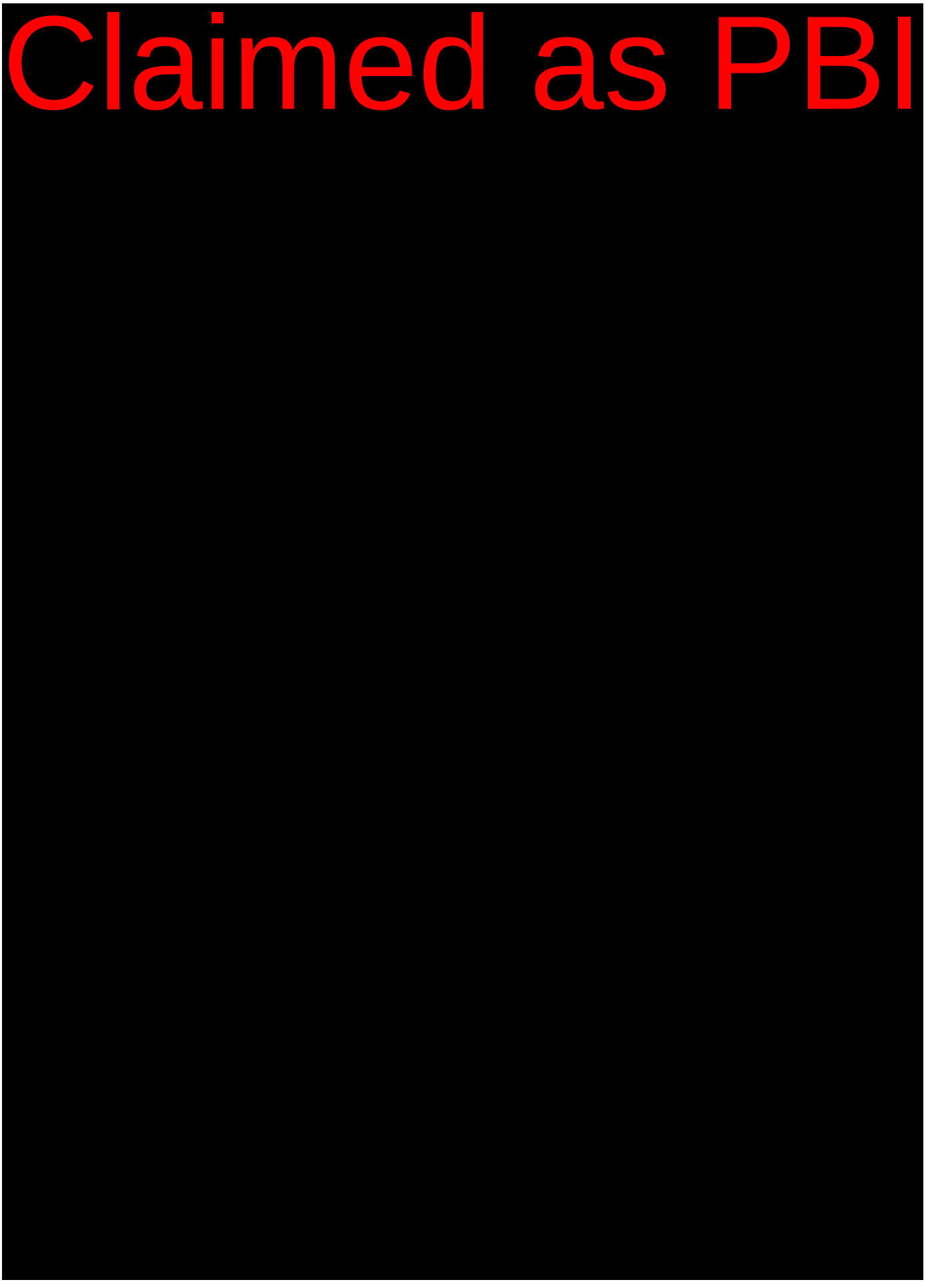
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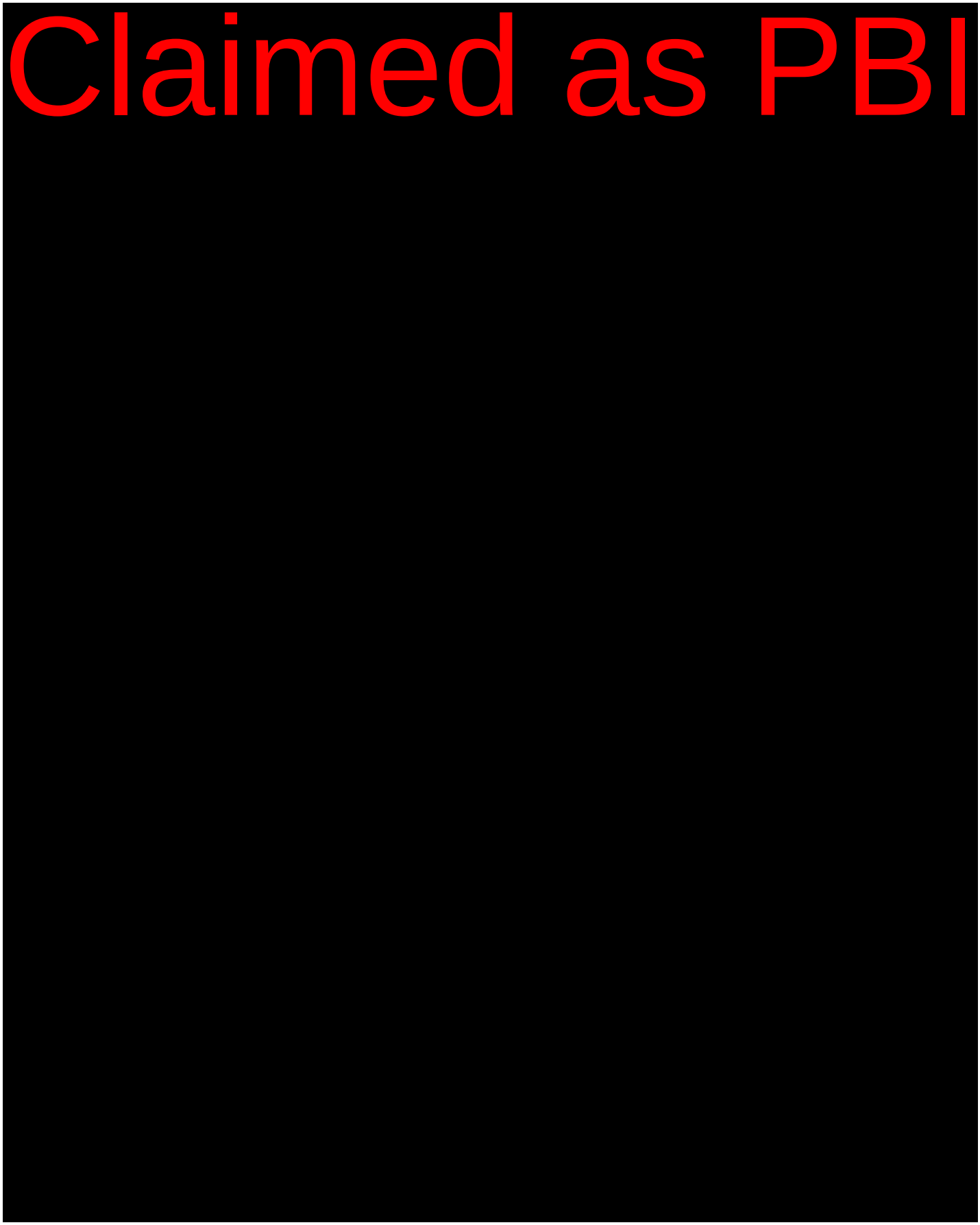
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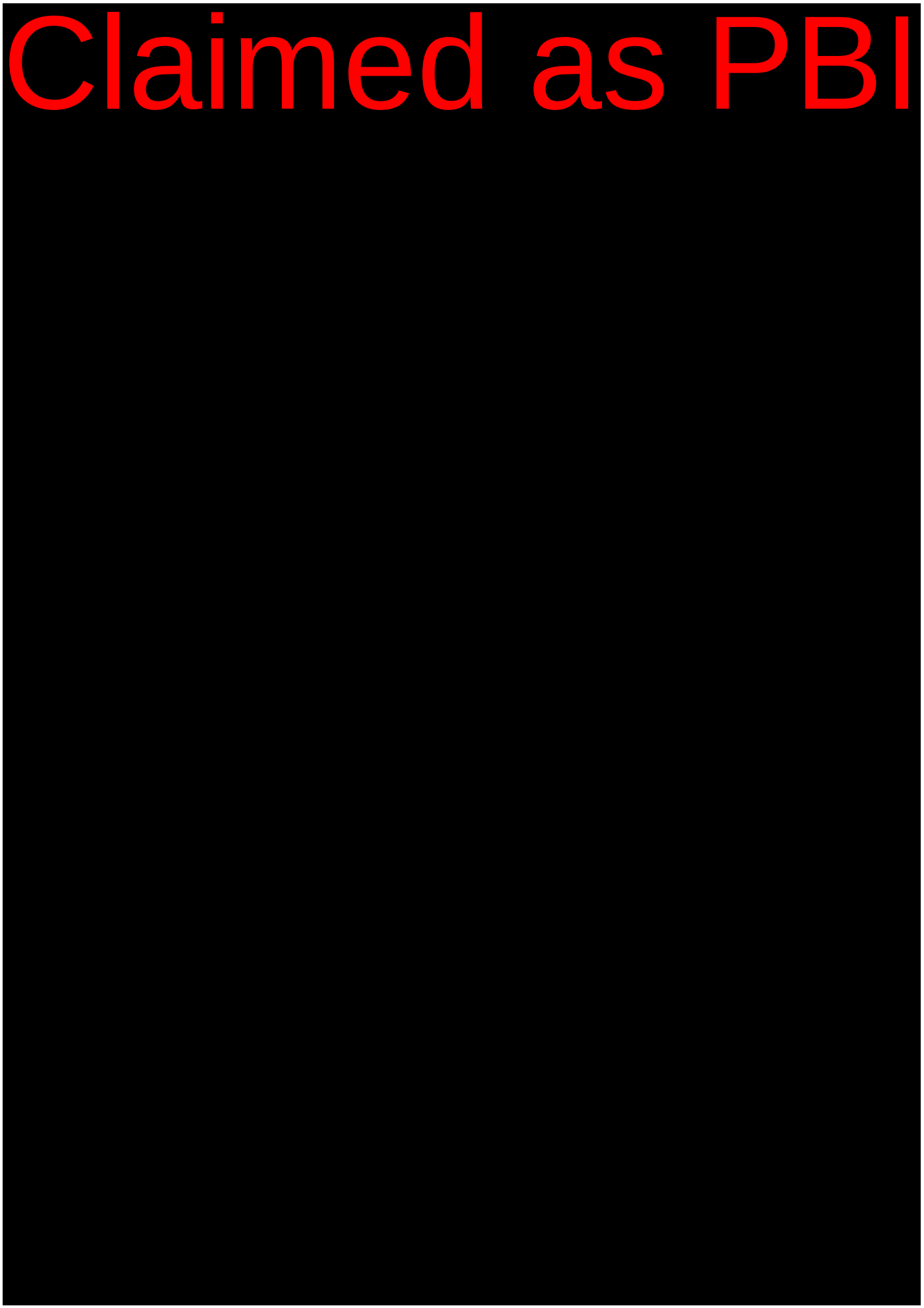
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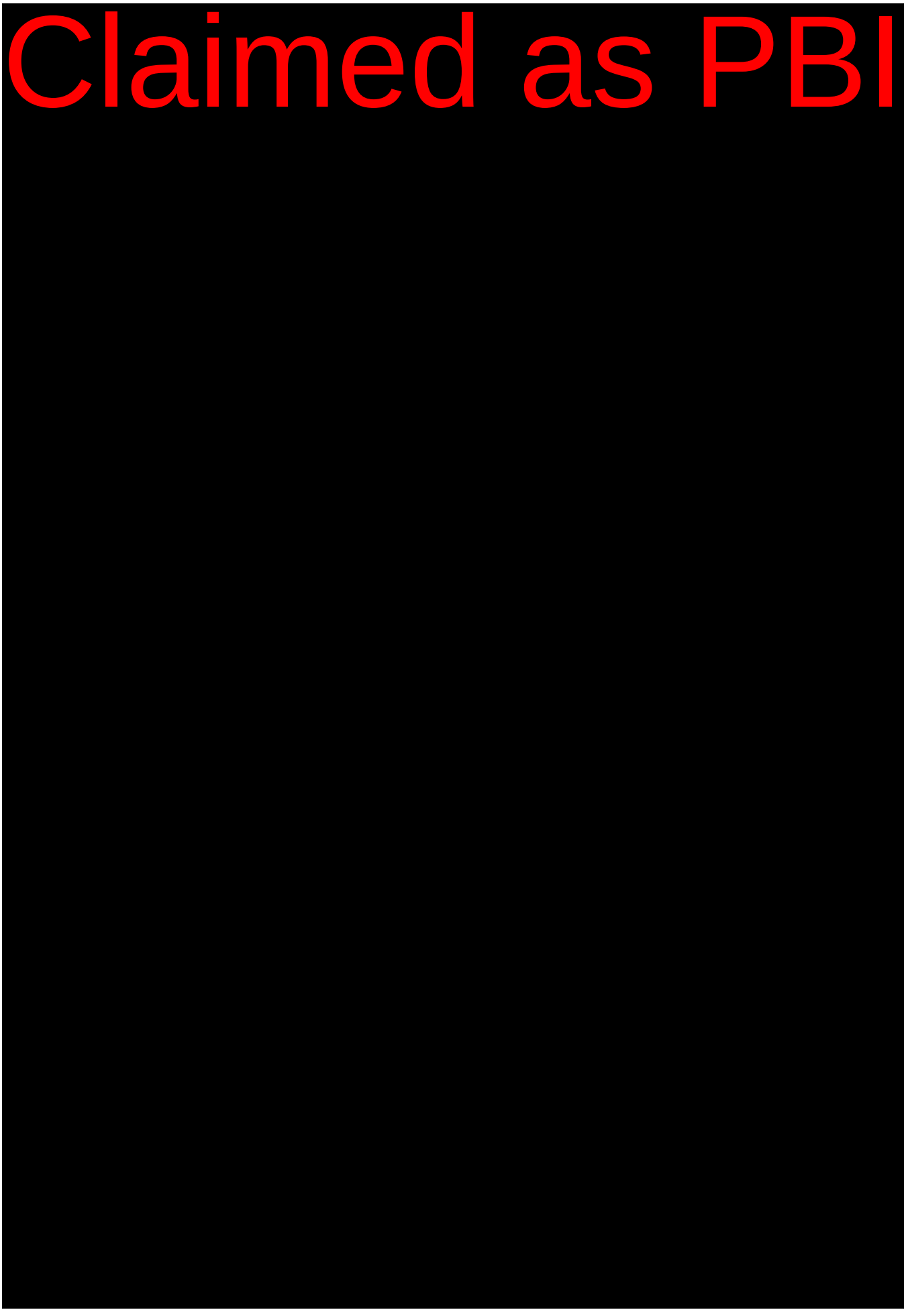
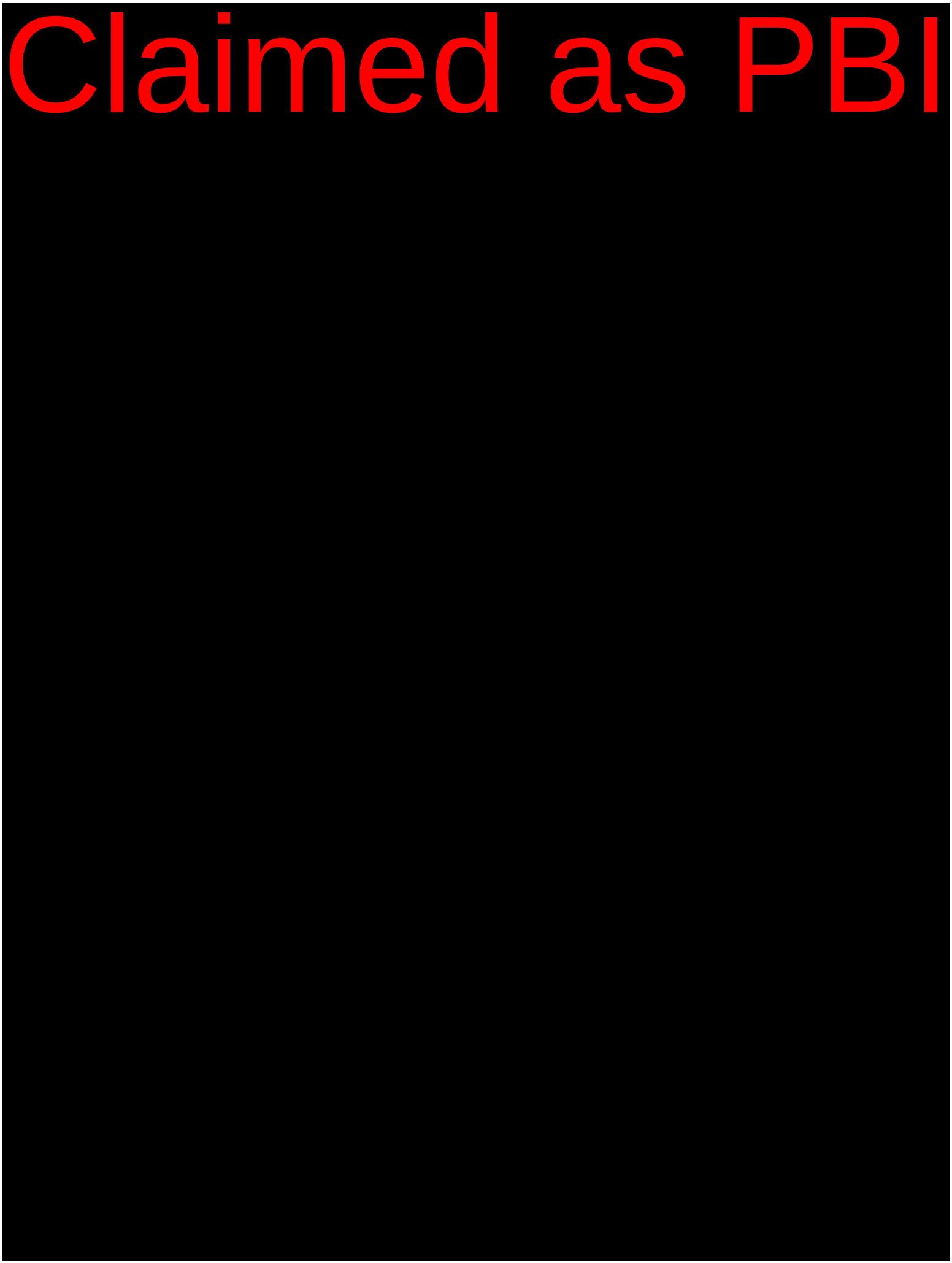

Claimed as PBI

Appendix 5
Claimed as PBI Water Quality Data

Claimed as PBI

Claimed as PBI

Claimed as PBI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