ACP-2017-079

SHETLAND SPACE CENTRE LIMITED (SAXAVORD SPACEPORT) AIRSPACE CHANGE PROPOSAL

CAP1616 STAGE 4B SUBMISSION

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DOCUMENT CONTROLS

Document Reference

AVISU Reference	ACP_2017_079_Stage_4_Submission_V1.0_FINAL

Version History

Version	Date	Status	Author	Comments
V1.0	7 Jul 23	Issued		Approved and submitted to CAA.

Document Quality Management

Role	Name	Email	Date Completed
Technical Author			3 Jul 23
Technical Reviewer			4 Jul 23
Quality Reviewer			5 Jul 23
Released by			7 Jul 23

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GLOSSARY OF TERMS AND ABBREVIATIONS

SaxaVord's convention is to introduce abbreviations at first use within any document. The table below, contains the list of abbreviations, acronyms and terms contained within this document.

Term/Abbreviation	Meaning
ACP	Airspace Change Proposal.
ADS-B	Automatic Dependent Surveillance-Broadcast. A surveillance technology and form of Electronic Conspicuity in which an aircraft determines its position via satellite navigation or other sensors and periodically broadcasts it, enabling it to be tracked.
AEE	Assessment of Environmental Effects
AMSL	Above Mean Sea Level.
ANSP	Air Navigation Service Provider.
AOI	Area of Interest
ATC/M	Air traffic Control/Management.
AQS	Air Quality Standard
Azimuth	(Launch) azimuths are the horizontal angular direction initially taken by a launch vehicle (LV) at lift-off, measured clockwise in degrees from true north.
BRRC	Blue Ridge Research & Consulting LLC
(UK) CAA	(UK) Civil Aviation Authority (i.e. the UK's aviation regulatory body).
(UK CAA) CAP1616	UK CAA Publication "Guidance on the regulatory process for changing the notified airspace design and planned and permanent redistribution of air traffic, and on providing airspace information".
CO2e	Carbon dioxide equivalent (CO2e) per kg of fuel burn. Carbon dioxide is the most prevalent atmospheric greenhouse gas and is the proxy by which greenhouse gas emissions are measured. CO2e allows other greenhouse gas emissions to be expressed in terms of carbon dioxide.
dB	Decibel is a logarithmic unit used to represent sound levels.
dBA	Weighting levels and curves have been developed to correspond to the sensitivity and perception of the human ear to different types of sound. The A-weighted decibel level (dBA) is commonly used to assess community sound.
EIA(R)	Environmental Impact Assessment Report
Eurocontrol	The European Organisation for the Safety of Air Navigation, commonly known as Eurocontrol (stylised EUROCONTROL), is an international organisation working to achieve safe and seamless air traffic management across Europe.
FIR	An airspace of defined dimensions in which a flight information and alerting services are provided, extending from the surface.
FL	Flight Level.
FTS	Flight Termination System
GA	General Aviation
ICAO	International Convention of Aviation Organisations.
IFR	Instrument Flight Rules, i.e. the conduct of the flight without visual references and the pilot is utilising cockpit instrumentation.
km	Kilometre
kg	Kilogram
LAMax	Maximum A-weighted Sound Level (LAMax) is the highest A-weighted sound level measured during a single event.

Term/Abbreviation	Meaning
LOA(s)	Letter(s) of Agreement
LP(s)	(SaxaVord Spaceport) Launch Pad(s)
LV(S)	(Orbital and Sub-orbital) Launch Vehicle(s).
MOU(s)	Memorandum (Memoranda) of Understanding.
nm	Nautical mile(s).
SIA	Space Industry Act (2018).
SIR	Space Industry Regulations
SSO	Sun-synchronous Orbit
SFC	Surface
UTC	Coordinated Universal Time (or UTC) is the primary time standard by which the world regulates clocks and time.
UIR	Upper Information Region. A Flight Information Region in upper airspace (not extending from the surface)
UNLTD	Unlimited
VFR	Visual Flight Rules adhered to by flights outside controlled airspace, where the conduct of the flight is with visual reference to - *inter alia* - terrain and other airspace users.

Table 1 - Glossary of Terms and Abbreviations

1. CONTENTS

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2. EXECUTIVE SUMMARY

The UK Space Innovation and Growth Strategy (IGS) sets out ambitious targets for the growth of the UK space sector, with 'Access to Space' being a key IGS theme. The UK has clearly stated its ambition to become a launching state, with the long term [*sic*] goal of being able to support suborbital operations and orbital delivery of small satellites.[1]

The Sceptre Project assessed that, geographically, the UK is well situated for launches to Polar and Sun-synchronous Orbits (SSO), which are in high demand from the growing communications and Earth observation markets, respectively. The report went on to offer that "[t]he market analysis clearly show[s] that a significant market could exist for a UK launch service"[2] and concluded that "[c]onsidering only the payload mass deliverable to orbit, a site in the Shetland Isles was determined as the best location in the UK to launch from as the trajectory avoids the populations in the Faroe Islands and Iceland".[3]

Shetland Space Centre Limited (trading and hereinafter referred to as "SaxaVord Spaceport" and "SaxaVord") seeks to conduct vertical launch operations for orbital and sub-orbital activities from SaxaVord Spaceport on Lamba Ness, Unst, which has a population of approximately 600 people. A suitable airspace reservation of defined dimensions is required to ensure the safety of other airspace users from SaxaVord launch activities and to ensure the safety of SaxaVord launch activities from other airspace users.

SaxaVord Spaceport resides within UK Class G airspace, which in turn sits underneath Class C airspace. The proposed airspace design would, therefore, extend from surface level to unlimited, through Classes G and C airspace, for specific and notified periods. There would be no change in airspace classification as a result of this proposal.

SaxaVord initiated its Airspace Change Proposal (ACP) in 2017. At Stage 1 of the ACP process, SaxaVord developed its airspace Design Principles with a selection of the application's stakeholders. Acknowledging that there were limited options by being tied to the location of the launch site, the launch trajectories available and the safety requirements as detailed in the following sections, SaxaVord developed potential airspace design options that addressed the Statement of Need and aligned with the agreed Design Principles.

At Stage 2, SaxaVord engaged its stakeholders to test the proffered design options against the Statement of Need and agreed Design Principles. SaxaVord received and analysed stakeholder feedback. SaxaVord assessed the developed options against the Design Principles and produced a corresponding design principles valuation (i.e. the Initial Options Appraisal). At Stage 2 the preferred design option was the segmented design (Design Option 2).

As Stage 2 progressed, performance data for potential launch vehicles (LVs) seeking to utilise the spaceport evolved; in turn, this precipitated a refinement of the proposed airspace design. Design Option 3, therefore, further refined the outline shape of the design and introduced a revised segmentation within. Moreover, SaxaVord determined that airspace design segmentation based on radials and range rings could be unnecessarily complicated. Consequently, SaxaVord refined the segmentation design concept for Stage 3, which would allow the activated airspace volume to be plotted more readily. In addition, the increase in internal segments would enable greater granularity in selecting the proportionate airspace volume for given spaceport launch operations.

1. Demios Space UK Ltd, "*Sceptre Report*" (2017), Page 2 ("*Executive Summary*") (online). Accessed on 27 Jun 23.
2. *ibid*.
3. *id*, Page 27.

At Stage 3, SaxaVord developed its Full Options Appraisal to provide the necessary additional rigorous evidence to support the selected and revised design option.

Unlike an airspace change at a UK aerodrome, there is no "current day" operation for the SaxaVord Spaceport to refer to as a baseline and, therefore, no *status quo* to maintain; any "baseline" position would be the prevailing air traffic situation at a given time. Accordingly, SaxaVord analysed a year's (2019) ADS-B surveillance data to establish a pre-COVID-19 "baseline" traffic assessment, enabling the identification of the potential impacts of SaxaVord's proposed airspace design on the ATM/airspace network and its users. A peak day and hour were identified and, during that epoch, 12 flights could be impacted by the activation of the proposed airspace design.

SaxaVord assumed an absolute worst-case scenario of an additional track-kilometrage for each impacted flight. Extrapolating this extended flight distance across the 12 flights and 30 instances (i.e. SaxaVord launches), the annual impacts for flight distance, fuel burn and CO2e could be shown to increase by 11,160km, 107tonnes and 341tonnes, respectively, representing a 0.39% (unmitigated) increase in all metrics above the measured baseline.

SaxaVord's Full options Appraisal concluded that the wider ATM/airspace network and its users could incorporate the unmitigated activation of Design Option 3 with minimal/negligible impact on the baseline prevailing traffic scenario. Moreover, the segmented airspace design would enable a reduced volume to be activated, commensurate with the launch profile and LV requirements; in turn, this could reduce impact further.

The Stage 3 Consultation Report summarises consultation responses, categorisation and SaxaVord associated analyses. Whilst responses and feedback prompted no changes or revisions to the proposed airspace design, "notification and coordination" associated with the activation and tactical management of access to the activated airspace was a key theme. This facet of managing the operation of the proposed airspace and its activation has been a consistent focus for SaxaVord throughout the ACP process, and SaxaVord continues to engage the relevant parties to progress the necessary letters of agreement and memoranda of understanding.

Stage 3 consultation also identified the potential need for a further 3 operating agreements with local aviation stakeholders in the vicinity of the spaceport, which are being progressed proactively.

Accordingly, Design Option 3 is submitted to CAA at Stage 4.

3. INTRODUCTION

Overview

1. Shetland Space Centre Limited (trading and hereinafter referred to as "SaxaVord Spaceport" and "SaxaVord") seeks to conduct vertical launch operations for orbital and sub-orbital activities from SaxaVord Spaceport on Lamba Ness, Unst. A suitable airspace reservation of defined dimensions is required to ensure the safety of other airspace users from SaxaVord launch activities and to ensure the safety of SaxaVord launch activities from other airspace users. The proposed airspace reservation would be activated for the minimum specified periods necessary to support nominated launch operations and would extend from surface (SFC) to unlimited (UNLTD).

4. CURRENT AIRSPACE DESCRIPTION

Structure and Routes

2. The Shetland Islands is a sub-Arctic archipelago in the Northern Atlantic, between Great Britain, the Faroe Islands and Norway and is the northernmost part of the United Kingdom. SaxaVord Spaceport is located on the Lamba Ness peninsula on Unst, the most northerly of the Shetland Islands. Situated in the north of the UK's airspace, SaxaVord Spaceport is 11nm south of the northern boundary of the Scottish Flight Information Region (FIR) and 22nm west of the FIR's eastern boundary.

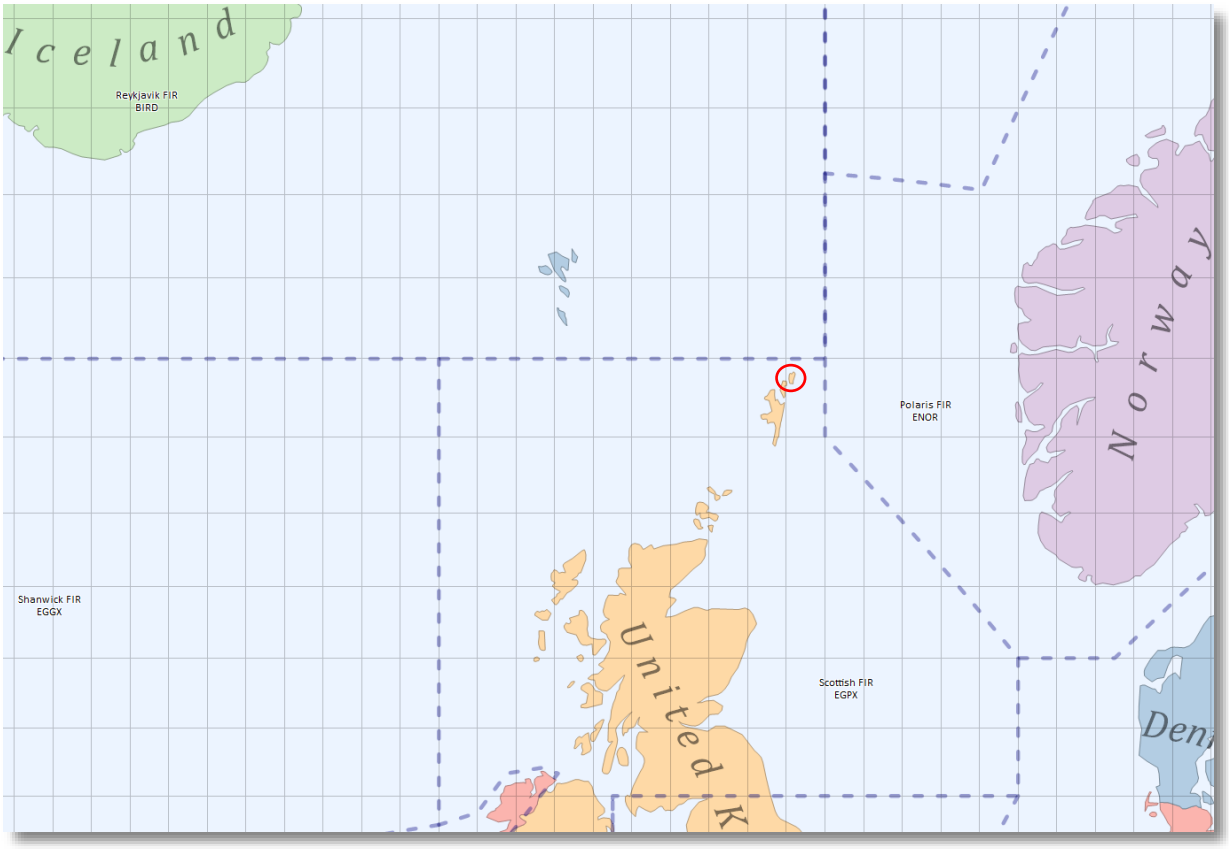


Figure 1 - SaxaVord Location

3. The SaxaVord site (and its immediate surroundings) resides wholly within UK Class G airspace, which in turn sits underneath Class C airspace. Proposed launch activities and airspace design would, therefore, extend from SFC to UNLTD, through Classes G and C airspace, for specific notified periods and beyond the lateral limits of the UK FIR and Upper Information Region (UIR). Above FL250 (i.e. 25,000ft AMSL) in the UK, commercial air traffic operates under the principle of "Free Route Airspace",

which allows flights to route direct, vice following prescribed routes (i.e. airways and upper air routes) along pre-determined navigation points. There would be no change in UK airspace classification as a result of this proposal.

4. Consequently, any proposed airspace design must consider the operating and operational requirements of local, national and international stakeholders and airspace users.

Airspace Usage and Proposed Effect

5. Unlike an airspace change at a UK aerodrome, there is no current day operation and airspace usage.

6. A suitable airspace reservation of defined dimensions is required to ensure the safety of other airspace users from SaxaVord launch activities and to ensure the safety of SaxaVord launch activities from other airspace users.

Operational Efficiency, Complexity, Delays and Choke Points

7. There is no current day operation and airspace usage; as such, there are no current operational efficiency, complexity, delay and choke point issues.

Safety Issues

8. There is no current day operation and airspace usage; as such, there are no current safety issues.

Environmental Issues

9. There is no current day operation and airspace usage; as such, there are no current environmental issues.

5. STATEMENT OF NEED

10. The application's DAP1916 was submitted initially on 15 Oct 18 and subsequently revised on 20 Sep 19:

> "Shetland Space Centre is looking to protect vertical launches from its spaceport. Protection will be required from surface up to orbit for protection of the rocket trajectory/flight path, prior to and after each launch. A suitable volume of airspace will be needed to ensure the separation of civil flying from launch activity."

11. The proposal forms part of the plan for delivering the UK's Airspace Modernisation Strategy.

6. DESCRIPTION OF PROPOSED AIRSPACE

12. SaxaVord seeks to establish an airspace reservation of defined and proportionate dimensions that can be tailored to the performance characteristics of any specific LV seeking to utilise the SaxaVord Spaceport for a specific launch. The proposed airspace design incorporates a box and wedge, the latter is segmented.

13. The segmentation allows the activated airspace volume to be plotted more readily by airspace users. In addition, internal segmentation enables greater granularity in selecting the most appropriate airspace volume for a given space launch operation. Furthermore, refined latitudes of segments have been selected to avoid coincidence with established FIR boundary reporting points. Latitudes and longitudes have been refined to ensure that segments do not traverse FIR boundaries.

14. The appropriate airspace volume would be activated by NOTAM for the minimum period necessary to facilitate spaceport launch operations to support up to 30 launches per annum.

7. IMPACTS AND CONSULTATION

ACP-2017-079 Summary of Stakeholder Engagement & Consultation

15. *Stage 1.* During Stage 1, SaxaVord considered and engaged relevant stakeholders to discuss the outline of the proposal and establish and share the proposed airspace DPs. The application's Stage 1 submission summarised Stage 1 stakeholder engagement and DP development.[4]

16. *Stage 2a.* At Stage 2A, SaxaVord developed the design options for the airspace change and tested them with stakeholders. Subsequently, at Stage 2B, SaxaVord carried out an options appraisal for the designs against requirements set by the CAA in an iterative approach. The application's Stage 2 (Develop & Assess) Submission summarises Stage 2 engagement responses and SaxaVord's corresponding analyses.[5]

17. *Stage 3.* At Stage 3 of the ACP process, SaxaVord completed its Full Options Appraisal[6] and consulted aviation and non-aviation stakeholders to identify, discuss and, where necessary, mitigate any subsequent impact(s) that activation of the proposed airspace design might have on stakeholders and their respective activities and operations.

18. *Stage 3 Consultation Report.* The Stage 3 Consultation Report summarises consultation responses, categorisation and SaxaVord associated analyses.[7] Whilst responses and feedback prompted no changes or revisions to the proposed airspace design, "notification and coordination" associated with the activation and tactical management of access to the activated airspace was a key theme. This facet of managing the operation of the proposed airspace and its activation has been a consistent focus for SaxaVord throughout the ACP process, and SaxaVord continues to engage the relevant parties to progress the necessary letters of agreement (LOAs) and memoranda of understanding (MOUs).

19. Stage 3 consultation also identified the potential need for a further 3 operating agreements with local aviation stakeholders in the vicinity of the spaceport, which are being progressed proactively.

Forecast Impacts of the Proposal

20. *Net Impacts Summary for Proposed Routes.* SaxaVord analysed surveillance data to establish a pre-COVID-19 baseline traffic assessment, from which to identify potential impacts of Design Option 3 on the traffic patterns of other airspace users. Considering macro and micro levels of airspace volumes enabled context and comparisons to be drawn and the maximum potential number of flights that could be impacted by the designs were identified; this enabled the subsequent analyses of the potential impacts of re-routing flights and an initial assessment on environmental considerations.

21. A peak day and hour were identified and, during that epoch, 12 flights could be seen to be impacted by the activation of Design Option 3. Flight distances were observed to be impacted by between -19 and +31km. SaxaVord assumed an absolute worst-case scenario of an additional 31km for each flight.

22. Extrapolating this extended flight distance across 12 flights and 30 instances (i.e. SaxaVord launches), the annual impacts for flight distance, fuel burn and CO2e could be shown to increase by 11,160km, 107tonnes and 341tonnes, respectively, representing a 0.39% (unmitigated) increase in all metrics above the measured baseline calculations. This analysis did not, however, consider Eurocontrol modelling and the identification of the most suitable launch window; SaxaVord views these latter activities as key mitigation measures in minimising impact on the network and its users.

4. ACP-2017-017, "Design Principles Gateway Submission" (online), accessed on 23 Jun 23
5. ACP-2017-017, "*Stage 2 (Develop & Assess) Submission*" (V3.0) (online), accessed on 3 Jul 23.
6. ACP-2017-017, "*Stage 3 Full Options Appraisal*" (V3.2) (online), accessed on 27 Jun 23.
7. ACP-2017-017, "*Stage 3 Consultation Report*" (online), accessed on 3 Jul 23.

23. The rerouting methodology applied offered a simplification of re-routing to avoid the active airspace reservation; the reality, however, would be notably different. Undoubtedly, flights' routes would be planned on the ground, prior to departure, to accommodate known airspace reservations and constraints across the whole of the flights' routes.

24. For the sample peak day and hour, the data showed that there were no flights below 7,000ft AMSL. When analysing the year's traffic data solely for aircraft operating below 7,000ft AMSL within the Design Option 3 volume, a different most impacted day was identified with at most 6 low-level aircraft throughput over the 24-hour period. When focussing on a peak operating hour, at most only 2 aircraft were impacted and these were over the sea.

25. The surveillance data did not have flight plan information on these flights, so, a re-route analysis was not possible. It is reasonable to assume, however, that these could be either local GA aircraft, or helicopter flights servicing North Sea infrastructure; as such, these flights could adjust their flight profiles and/or schedules to deconflict with the activation of the proposed airspace design and corresponding aeronautical restriction.

26. The Full Options Appraisal provides greater detail, data and information and analyses on the impacts on aviation users as a result of activation of the proposed airspace design. For the purposes of this submission, the corresponding sections of the Full Options Appraisal have been reproduced at Annex A, below.

27. *Units Affected by the Proposal.* Stakeholders, including ANSPs and ATSUs, potentially impacted by the proposed airspace design were identified, engaged and consulted at Stages 2 and 3. The list of those stakeholders engaged at Stage 3 is provided in the Stage 3 Consultation Report.[8] SaxaVord continues to engage with the relevant parties to progress the necessary LOAs and MOUs associated with the activation of the proposed airspace design. Annex B refers.

28. *Military Impact and Consultation.* MOD was engaged and consulted formally at Stages 2 and 3 (Para 27, above, refers). SaxaVord recognises, however, that certain airspace users might require access to the airspace reservation for specific activities (i.e. certain military flights) and is engaged with the MOD to establish the requisite LOA/MOU to facilitate such access under prescribed conditions; this LOA/MOU with MOD also seeks to ensure the appropriate deconfliction of spectrum usage with local MOD infrastructure. Annex B, below, refers.

29. General *Aviation (GA) Airspace Users Impact and Consultation.* The proposed airspace design would have a negligible impact on the minimal GA operations in Unst. GA representative bodies engaged at Stage 2 and consulted at Stage 3 are listed in Stage 2 Submission materials (Appendix 1)[9] and Stage 3 Consultation Report (Appendix 1)[10], respectively.

30. The potential GA users impact of the activation of the proposed airspace design is provided in Appendix 1 of the Stage 3 Full Options Appraisal, which has been reproduced at Annex C, below

31. *Commercial Air Transport Impact and Consultation.* The potential commercial air transport impact of the activation of the proposed airspace design is provided in the corresponding sections and Appendix 1 of the Stage 3 Full Options Appraisal, which have been reproduced at Annexes A and C, below.

32. *CO2 Environmental Analysis Impact and Consultation.* The potential CO2 environmental analysis impact of the activation of the proposed airspace design is provided in the corresponding sections

8. ACP-2017-079, "*Stage 3 Consultation Report*" (V1.0), Appendix 1 (online), accessed 3 Jul 23.
9. ACP-2017-079, "*Stage 2 Submission*" (V3.0), Appendix 1 (online), accessed on 23 Jun 23.
10. ACP-2017-079, "*Stage 3 Consultation Report*" (V1.0), Appendix 1 (online), accessed 3 Jul 23.

and Appendix 1 of the Stage 3 Full Options Appraisal, which have been reproduced at Annexes A and C, below.

33. *Local Environmental Analysis Impacts and Consultation.* The potential local environmental analysis impacts of the activation of the proposed airspace design are provided in Appendix 1 of the Stage 3 Full Options Appraisal, which has been reproduced at Annex C, below.

34. *Economic Impacts.* Where practicable, the potential economic impacts of the activation of the proposed airspace design are provided in Appendix 1 of the Stage 3 Full Options Appraisal, which has been reproduced at Annex C, below.

8. ANALYSIS OF OPTIONS

35. Airspace design options were developed around recommended trajectories based on assessment criteria contained within the UKSA (*et al*)-sponsored SCEPTRE (Project Final) Report.[11] The Project assessed that, geographically, the UK is well situated for launches to Polar and Sun-synchronous Orbits (SSO), which are in high demand from the growing communications and Earth observation markets, respectively. In considering launch trajectories and, therefore, airspace design options, an immutable safety principle of the SCEPTRE project was that LVs cannot overfly populated areas.

36. The report concluded that, "[c]onsidering only the payload mass deliverable to orbit, a site in the Shetland Isles was determined as the best location in the UK to launch from as the trajectory avoids the populations in the Faroe Islands and Iceland".[12]

37. At Stage 2, SaxaVord presented options that addressed the Statement of Need and aligned with the Stage 1 Design Principles (DPs)[13], acting on the constraints identified by both the Change Sponsor and the SCEPTRE Report[14] and the recommendations of the latter to ensure that current and future launch operation requirements can be accommodated. This approach aligns with the requirements of CAP1616, Para 127.

11. Demios Space UK Ltd, "*Sceptre Report*" (2017) (online), accessed on 27 Jun 23.
12. *id,* Page 27.
13. ACP-2017-079 "*Design Principles Second Gateway Submission*" (online), accessed on 27 Jun 23.
14. Demios Space UK Ltd, "*Sceptre Report*" (2017), Page 2 (online). Accessed on 27 Jun 23.

Stage 2 Initial Options Appraisal

38. The airspace design options presented at Stage 2 were for a combined "box and wedge" shape with 2 variations: one non-segmented (Design Option 1), the other segmented (Design Option 2). The Initial Options Appraisal concluded the following:

a. Design Option 1:

(1) Addressed the Statement of Need.

(2) In principle, aligned with the DPs.

(3) Notwithstanding the foregoing, Design Option 1 could be seen to have more impact on other airspace users than Design Option 2 by only partially meeting DP3.

(4) A corresponding version of CAP1616 Table E2 for Design Option 1 was presented at Appendix 11 of the application's Stage 2 submission materials.[15]

b. Design Option 2:

(1) Addresses the Statement of Need.

(2) Aligning with the defined DPs.

(3) Moreover, compared with Design Option 1, Design Option 2 could be seen to have a reduced impact on other airspace users, meeting the requirement of DP3 more fully.

(4) A corresponding version of CAP1616 Table E2 for Design Option 2 is at Appendix 12 of the application's Stage 2 submission materials.[16]

39. As a result of Stage 2, the preferred design option taken forward to Stage 3 was the segmented design (Design Option 2). As Stage 2 progressed, however, performance data for potential launch vehicles (LVs) seeking to utilise the spaceport evolved; in turn, this precipitated a refinement of the airspace design being proposed at Stage 3.

Design Option Evolution - "Design Option 3"

40. Design Option 3 further refined the "box" shape and introduced a revised segmentation mechanism within the "wedge" shape and remained the only design option to be consulted upon at Stage 3.

41. *Evolution of Box and Wedge Design*.

a. *Box*. The co-ordinates of the corners of the box element have been rounded for ease of use. The refinement of the co-ordinates does not materially change the location or shape of the box.

b. *Wedge*. From the northern corners of the box, the east and west radials are now approximately +/-40° from the centreline (360°True (360T)) to accommodate the new limiting case dispersion of trajectory for a passive guidance sub-orbital LV.

c. From the southern corners of the box, additional east and west radials are added to allow for sub-orbital launch azimuths to the east and west of north (main axis of the airspace).

d. Downrange, the sides of the wedge are aligned north/south, instead of the previous triangular shape, to remove unnecessary airspace volume for dispersion of trajectory of a

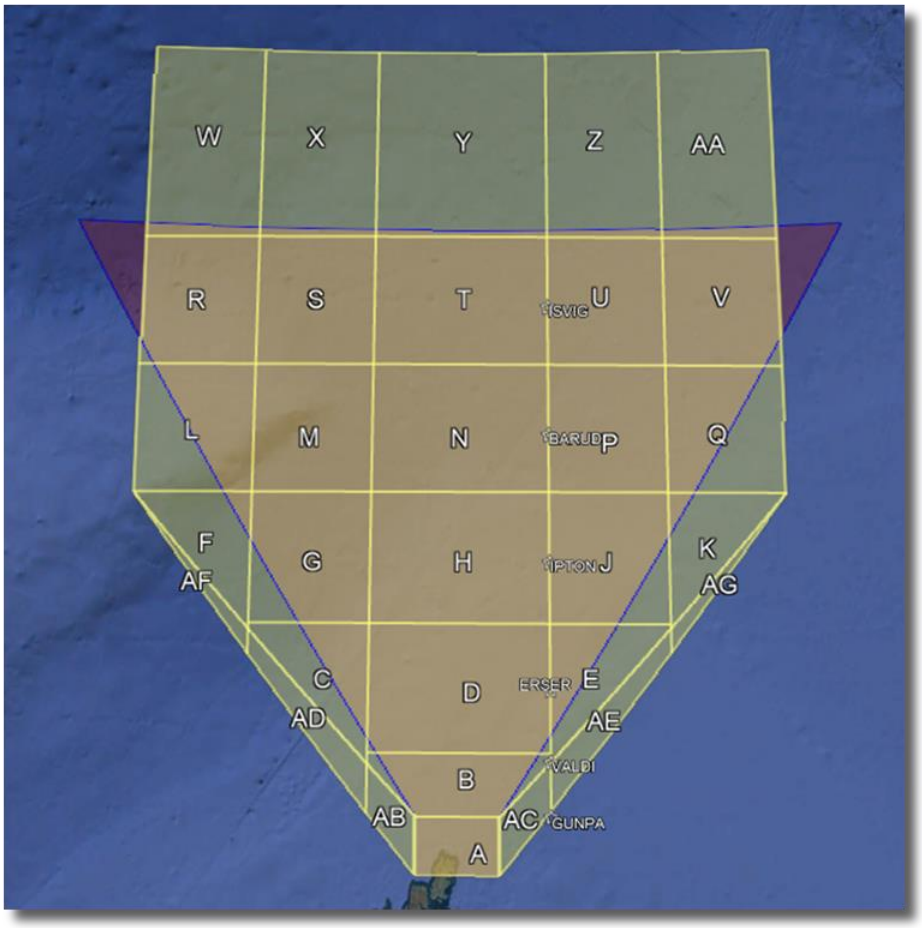
15. ACP-2017-079 "*Stage 2 Submission (V3.0)*", Appendix 11 (online), accessed 26 Jun 23.
16. *id*, Appendix 12 (online), accessed 26 Jun 23. Corresponding appendix revised for Design Option 3 the Full Options Appraisal and reproduced at Annex C, below.

passive guidance sub-orbital LV. The downrange limit of the wedge has been extended to accommodate the new limiting case dispersion of trajectory for a passive guidance sub-orbital LV.

42. *Evolution of Design Option 3 - Segmentation*. At Stage 2, the original segmented design concept proposed segments based on radials and range rings. Subsequently, SaxaVord determined that this could be an unnecessarily complicated solution to implement, as there would be many complex co-ordinates and some individual segments could traverse FIR boundaries. Consequently, SaxaVord refined the segmentation concept for Stage 3, which uses segments based on simplified lines of latitude and longitude.

Design Option 3

43. Figure 2, below, indicates Design Option 3 with revised segmentation, compared with the red Stage 2 "box and wedge" design; the box element (Segment A) remains consistent. The overall longitudinal dimension of the airspace has increased by 42nm and the overall latitudinal dimension has decreased by 32nm.



Source: Google Earth

Figure 2 - Design Option 3 (Segmentation) Compared With Stage 2 "Box and Wedge"

44. This design evolution between Stages 2 and 3 is articulated fully in the application's Full Options Appraisal[17] and highlighted similarly to the Application's stakeholders in the Stage 3 stakeholder consultation materials.

17. ACP-2017-017 "*Stage 3 Full Options Appraisal (V3.2)*", Paras 6-13 (online), accessed on 27 Jun 23.

Stage 3 Full Initial Options Appraisal

45. At Stage 3, Step 3, SaxaVord concluded that, even in a most limiting case, the wider ATM/airspace network and its users could incorporate the activation of Design Option 3 with minimal/negligible impact on the baseline prevailing traffic scenario. Moreover, the inherent flexibility of Design Option 3 would enable a reduced airspace volume, commensurate with the launch profile and LV requirements, to be incorporated more readily, reducing impact further.

46. Consequently, Design Option 3 was taken forward and informed the stakeholder consultation activities in Stage 3.

Stage 4 Final Options Appraisal

47. The Stage 3 stakeholder responses and SaxaVord's analyses thereof (summarised at Paras 18 and 19, above) concluded that there was no redesign requirement for the ACP-2017-079 proposed airspace reservation. Thus, the ACP-2017-079 Full Options Appraisal becomes the *de facto* Final Options Appraisal.

9. AIRSPACE DESCRIPTION REQUIREMENTS

48. SaxaVord's assessment of the Airspace Description Requirements for ACP-2017-079 are contained within Table 2, below.

	The proposal should provide a full description of the proposed change including the following:	Description for this Proposal
a	The type of route or structure; for example, airway, UAR, Conditional Route, Advisory Route, CTR, SIDs/STARs, holding patterns, etc.	As set out on the application's ACP portal[18], this proposal is for a permanent change to the notified airspace design, and the change level is 1. "Shetland Space Centre is looking to protect vertical launches from its spaceport. Protection will be required from surface up to orbit for protection of the rocket trajectory/flight path, prior to and after each launch. A suitable volume of airspace will be needed to ensure the separation of civil flying from launch activity".[19] SaxaVord believes that the appropriate airspace structure would be a "Special Use Area" (SUA). There would be no change in airspace classification as a result of this proposal.[20]
b	The hours of operation of the airspace and any seasonal variations	The proposed airspace reservation would be activated for the minimum specified periods necessary to support nominated launch operations and would extend from surface (SFC) to unlimited (UNLTD). SaxaVord anticipates that launch windows will be approximately of one-hour duration and anticipates 30 launches *per annum*. Over the life of the operation it is expected that seasonal variations will be small. See Annex A.

18. ACP-2017-079 ACP Portal "*Purpose of Change*" (online), accessed on 23 Jun 23.
19. *ibid*.
20. CAP1616, Page 71, Para 251 "Decisions by the Secretary of State" (online), accessed on 23 Jun 23.

	The proposal should provide a full description of the proposed change including the following:	Description for this Proposal
c	Interaction with domestic and international en-route structures, TMAs or CTAs with an explanation of how connectivity is to be achieved. Connectivity to aerodromes not connected to CAS should be covered.	Interaction with domestic and international en route structures is explained in the ACP-2017-079 Stage 3 Full Options Appraisal; the corresponding elements have been reproduced at Annex A.[21] Interaction with TMAs and/or CTAs and achievement of associated connectivity is not applicable to ACP-2017-079. Similarly, connectivity to aerodromes not connected to CAS is not applicable to ACP-2017-079.
d	Airspace buffer requirements (if any). Where applicable describe how the CAA policy statement on 'Special Use Airspace - Safety Buffer Policy for Airspace Design Purposes' has been applied.	CAA policy statement on 'Special Use Airspace - Safety Buffer Policy for Airspace Design Purposes' has been applied as far as practical . Airspace buffers are inherent within the dimensions of the proposed airspace design as per safety target and flight safety analysis. However, any additional buffers allocated to the routes and tracking of aircraft outside the boundary by the ANSP is not possible to apply. See section 5.2 of the Stage 4 safety assessment submitted.
e	Supporting information on traffic data including statistics and forecasts for the various categories of aircraft movements (passenger, freight, test and training, aero club, other) and terminal passenger numbers.	The proposal is for a suitable airspace reservation of defined dimensions to ensure the safety of other airspace users from SaxaVord launch activities and *vice versa*. Traffic data applies to flights potentially impacted by activation of the proposed airspace design and is articulated fully in the ACP-2017-079 Stage 3 Full Options appraisal. See Annex A. Unlike an aerodrome, categorisation of aircraft movements and terminal passenger numbers do not apply to ACP-2017-079
f	Analysis of the impact of the traffic mix on complexity and workload of operations.	There will be no mix of traffic in area of the proposed airspace reservation; thus, there is no corresponding impact on the complexity and workload of operations. SaxaVord's analysis of the potential re-route of flights impacted by the activation of the proposed airspace reservation is offered in the ACP-2017-079 Full Options appraisal. See Annex A.
g	Evidence of relevant draft Letters of Agreement, including any arising out of consultation and/or airspace management requirements.	LOAs and MOUs are summarised at Annex B, Table 10. Copies of signed and emergent LOAs/MOUs are provided at Annex B, Appendices 1-5. As indicated at Table 10, the potential requirement for 3 further LOAs/MOUs is being discussed between SaxaVord and the relevant parties.

21. *id*, Paras 24-28 (online), accessed on 27 Jun 23.

	The proposal should provide a full description of the proposed change including the following:	Description for this Proposal
h	Evidence that the airspace design is compliant with ICAO Standards and Recommended Practices (SARPs) and any other UK policy or filed differences, and UK policy on the Flexible Use of Airspace (or evidence of mitigation where it is not).	The proposal is for a suitable airspace reservation of defined dimensions to ensure the safety of other airspace users from SaxaVord launch activities and vice versa. Unlike an aerodrome, ICAO SARPs are not applicable to ACP-2017-079. The operating principles of the proposed airspace design are that only using the airspace necessary for the specific launch type and for the minimum amount of time necessary, aligns with the principles of FUA. It, therefore, follows that the application is compliant UK Policy on FUA.
i	The proposed airspace classification with justification for that classification.	When activated, the proposed airspace volume's vertical dimension will extend from surface (SFC) to unlimited (ULTD); therefore, the airspace volume will comprise UK Classes G and C airspace. Para 3, above, refers. There would be no change in airspace classification as a result of this proposal.[22]
j	Demonstration of commitment to provide airspace users equitable access to the airspace as per the classification and where necessary indicate resources to be applied or a commitment to provide them in line with forecast traffic growth. 'Management by exclusion' would not be acceptable.	The proposal is for a suitable airspace reservation of defined dimensions to ensure the safety of other airspace users from SaxaVord launch activities and *vice versa*. When activated, the purpose of the airspace reservation is to ensure safety by exclusion; thus, there will be no equitable access to the airspace during its windows of activation. SaxaVord recognises, however, that certain airspace users might require access to the airspace reservation for specific activities (i.e. certain military and search and rescue flights) and is engaged with the relevant parties to establish the requisite LOAs/MOUs to facilitate such access under prescribed conditions. Annex B, below, refers.
k	Details of and justification for any delegation of ATS.	Delegation of ATS is not directly applicable to ACP-2017-079 and the activation of the proposed airspace design. No related observations pertaining to existing ATS delegation in the impact FIR has been raised during either Stage 2 engagement or Stage 3 consultation.

Table 2 - Airspace Description Requirements

10. SAFETY ASSESSMENT

49. The ACP-2017-79 "ACP Safety Assessment" document[23] provides the safety assessment of the proposed permanent airspace reservation and has been submitted separately.

22. CAP1616, Page 71, Para 251 "Decisions by the Secretary of State" (online), accessed on 23 Jun 23.
23. LP-015-SAXA dated 7 Jul 23.

11. OPERATIONAL IMPACT

50. SaxaVord's assessment of the Operational Impact for ACP-2017-079 is contained within Table 3, below.

	An analysis of the impact of the change on all airspace users, airfields and traffic levels must be provided, and include an outline concept of operations describing how operations within the new airspace will be managed. Specifically, consideration should be given to:	Evidence of compliance/proposed mitigation
a	Impact on IFR general air traffic and operational air traffic or on VFR General Aviation (GA) traffic flow in or through the area.	The potential impact on IFR general air traffic (i.e. commercial flights) as a result of activation of the proposed airspace design is detailed in the Stage 3 Full Options Appraisal. See Annex A. MOD did not cite an impact on operational air traffic, *per se*. SaxaVord is engaged with the MOD to establish an LOA to facilitate MOD flights' access to the activated airspace design under prescribed conditions. Annex B, below, refers. The potential GA users impact of the activation of the proposed airspace design is provided in the Stage 3 Full Options Appraisal. See Annex C.
b	Impact on VFR operations (including VFR routes where applicable).	Activation of the proposed airspace design would have a negligible impact on the minimal GA operations in Unst. The potential GA users impact of the activation of the proposed airspace design is provided in the Stage 3 Full Options Appraisal. See Annex C.
c	Consequential effects on procedures and capacity, i.e. on SIDs, STARs, and/or holding patterns. Details of existing or planned routes and holds.	Unlike an aerodrome, consequential effects on procedures and capacity and details of existing or planned routes and holds are not applicable to ACP-2017-079.
d	Impact on aerodromes and other specific activities within or adjacent to the proposed airspace.	There are no active aerodromes adjacent to the proposed airspace reservation. Specific activities in the vicinity of the airspace are mainly confined to helicopter flights servicing North Sea infrastructure; as such, these flights could adjust their flight profiles and/or schedules to deconflict with the activation of the proposed airspace design and corresponding aeronautical restriction. Para 25, above, refers. SaxaVord recognises, however, that certain airspace users might require access to the airspace reservation for specific activities (i.e. certain military and search and rescue flights) and is engaged with the relevant parties to establish the requisite LOAs/MOUs to facilitate such access under prescribed conditions. Annex B, below, refers.

	An analysis of the impact of the change on all airspace users, airfields and traffic levels must be provided, and include an outline concept of operations describing how operations within the new airspace will be managed. Specifically, consideration should be given to:	Evidence of compliance/proposed mitigation
e	Any flight planning restrictions and/or route requirements.	The proposal is for a suitable airspace reservation of defined dimensions to ensure the safety of other airspace users from SaxaVord launch activities and *vice versa*. Notification of the activation of the proposed airspace design would be by NOTAM. Details of flight planning restrictions and/or route requirements associated with the activation of the proposed airspace design are detailed in the Full Options appraisal. See Annex A.

Table 3 - Operational Impact

12. SUPPORTING INFRASTRUCTURE RESOURCES

51. SaxaVord's assessment of Supporting Infrastructure Resources for ACP-2017-079 is contained within Table 4, below.

	General requirements	Evidence of compliance/proposed mitigation
a	Evidence to support RNAV and conventional navigation as appropriate with details of planned availability and contingency procedures.	The support, availability and contingency for RNAV and conventional navigation are not applicable to ACP-2017-079. The proposal is for a suitable airspace reservation of defined dimensions to ensure the safety of other airspace users from SaxaVord launch activities and *vice versa*.
b	Evidence to support primary and secondary surveillance radar (SSR) with details of planned availability and contingency procedures.	The support, availability and contingency for primary radar and SSR are not applicable to ACP-2017-079.
c	Evidence of communications infrastructure including R/T coverage, with availability and contingency procedures.	Communications infrastructure requirements are not applicable to ACP-2017-079. Communication procedures for SaxaVord Spaceport launch operations during the activation of the proposed airspace continue to be developed in the relevant LOAs/MOUs; Annex B refers.
d	The effects of failure of equipment, procedures and/or personnel with respect to the overall management of the airspace must be considered.	Procedures for SaxaVord Spaceport launch operations during the activation of the proposed airspace continue to be developed in the relevant LOAs/MOUs; Annex B refers.
e	Effective responses to the failure modes that will enable the functions associated with airspace to be carried out including details of navigation aid coverage, unit personnel levels, separation standards and the design of the airspace in respect of existing international standards or guidance material.	Not applicable to ACP-2017-079 There is no requirement for effective responses to the failure modes that will enable the functions associated with airspace to be carried out including details of navigation aid coverage, unit personnel levels, separation standards and the design of the airspace in respect of existing international standards or guidance material. Failure of communications capabilities which might preclude direct contact with the SaxaVord Spaceport launch operations during the activation of the proposed airspace continue to be developed in the relevant LOAs/MOUs; Annex B refers.

	General requirements	Evidence of compliance/proposed mitigation
f	A clear statement on SSR code assignment requirements.	SSR code assignment requirements are not applicable to ACP-2017-079. There are no SSR code assignment requirements associated with the proposal.
g	Evidence of sufficient numbers of suitably qualified staff required to provide air traffic services following the implementation of a change.	SaxaVord Spaceport is not an ATSU, therefore, this element is not applicable to ACP-2017-079. The implementation of the proposed change will not impact suitably qualified staff required to provide air traffic services, who are required to familiarise themselves with the latest promulgated orders, instructions, notices and signals (including those associated with airspace reservations) prior to undertaking their operational tasks.

Table 4 - Supporting Infrastructure Resources - General Requirements

13. AIRSPACE AND INFRASTRUCTURE

Airspace & Infrastructure - General Requirements

52. SaxaVord's assessment of Airspace & Infrastructure - General Requirements for ACP-2017-079 is contained within Table 5Table 4, below.

	General requirements	Evidence of compliance/proposed mitigation
a	The airspace structure must be of sufficient dimensions with regard to expected aircraft navigation performance and manoeuvrability to fully contain horizontal and vertical flight activity in both radar and non-radar environments	The sufficiency of dimensions of the proposed airspace structure dimensions relative to the expected navigation performance and manoeuvrability to fully contain horizontal and vertical flight activity in both radar and non-radar environments is not applicable to ACP-2017-079. The airspace structure will, however, be of sufficient dimensions and tailored to LVs' operating requirements. When activated, the purpose of the proposed airspace reservation is to ensure safety by exclusion; during its periods of activation, there will be no aircraft operating in the airspace.
b	Where an additional airspace structure is required for radar control purposes, the dimensions shall be such that radar control manoeuvres can be contained within the structure, allowing a safety buffer. This safety buffer shall be in accordance with agreed parameters as set down in CAA policy statement 'Safety Buffer Policy for Airspace Design Purposes Segregated Airspace'. Describe how the safety buffer is applied, show how the safety buffer is portrayed to the relevant parties, and provide the required agreements between the relevant ANSPs/ airspace users detailing procedures on how the airspace will be used. This may be in the form of Letters of Agreement with the appropriate level of diagrammatic explanatory detail.	Not applicable to ACP-2017-079; the additional airspace structure is not required for radar control purposes. The proposal is for a suitable airspace reservation of defined dimensions to ensure the safety of other airspace users from SaxaVord launch activities and *vice versa*.

	General requirements	Evidence of compliance/proposed mitigation
c	The Air Traffic Management system must be adequate to ensure that prescribed separation can be maintained between aircraft within the airspace structure and safe management of interfaces with other airspace structures	Not applicable to ACP-2017-079. When activated, the purpose of the airspace reservation is to ensure safety by exclusion; as such, and except for those specific prescribed conditions in the relevant LOAs/MOUs, there will be no requirement to ensure that prescribed separation can be maintained between aircraft within the airspace structure and safe management of interfaces with other airspace structures.
d	Air traffic control procedures are to ensure required separation between traffic inside a new airspace structure and traffic within existing adjacent or other new airspace structures	Not applicable to ACP-2017-079. When activated, the purpose of the airspace reservation is to ensure safety by exclusion.
e	Within the constraints of safety and efficiency, the airspace classification should permit access to as many classes of user as practicable	Not applicable to ACP-2017-079. Notwithstanding the airspace classification of the proposed airspace, when activated, the purpose of the airspace reservation is to ensure safety by exclusion. When activated, there will be no permitted access to the airspace during its activation period. SaxaVord recognises, however, that certain airspace users might require access to the airspace reservation for specific activities (i.e. certain military and search and rescue flights) and is engaged with the relevant parties to establish the requisite LOAs/MOUs to facilitate such access under prescribed conditions. Annex B, below, refers.
f	There must be assurance, as far as practicable, against unauthorised incursions. This is usually done through the classification and promulgation	The activation of the proposed airspace reservation will be notified and promulgated by NOTAM for the minimum period required to facilitate spaceport launch operations.
g	Pilots shall be notified of any failure of navigational facilities and of any suitable alternative facilities available and the method of identifying failure and notification should be specified	Not applicable to ACP-2017-079; there are no navigational facilities associated with the proposed airspace reservation.
h	The notification of the implementation of new airspace structures or withdrawal of redundant airspace structures shall be adequate to allow interested parties sufficient time to comply with user requirements. This is normally done through the AIRAC cycle	If the application is successful, the proposed airspace structure will be promulgated through the UK AIRAC cycle.
i	There must be sufficient R/T coverage to support the Air Traffic Management system within the totality of proposed controlled airspace	Not applicable to ACP-2017-079; the proposed airspace is not controlled airspace.
j	If the new structure lies close to another airspace structure or overlaps an associated airspace structure, the need for operating agreements shall be considered	LOAs and MOUs are summarised at Annex B, Table 10. Copies of signed and emergent LOAs/MOUs are provided at Annex B, Appendices 1-5. As indicated at Table 10, the potential requirement for 3 further LOAs/MOUs is being discussed with the relevant parties.

	General requirements	Evidence of compliance/proposed mitigation
k	Should there be any other aviation activity (low flying, gliding, parachuting, microlight site, etc) in the vicinity of the new airspace structure and no suitable operating agreements or air traffic control procedures can be devised, the change sponsor shall act to resolve any conflicting interests	LOAs and MOUs are summarised at Annex B, Table 10. Copies of signed and emergent LOAs/MOUs are provided at Annex B, Appendices 1-5. As indicated at Table 10, the potential requirement for 3 further LOAs/MOUs is being discussed with the relevant parties.

Table 5 - Airspace & Infrastructure - General Requirements

Airspace & Infrastructure - ATS Route Requirements

53. SaxaVord's assessment of Airspace & Infrastructure - ATS Route Requirements for ACP-2017-079 is contained within Table 6Table 4, below.

	ATS route requirements	Evidence of compliance/proposed mitigation
a	There must be sufficient accurate navigational guidance based on in-line VOR/DME or NDB or by approved RNAV derived sources, to contain the aircraft within the route to the published RNP value in accordance with ICAO/Eurocontrol standards.	Not applicable to ACP-2017-079. The proposal is for a suitable airspace reservation of defined dimensions to ensure the safety of other airspace users from SaxaVord launch activities and *vice versa*. There is no impact on RNAV and conventional navigation.
b	Where ATS routes adjoin terminal airspace there shall be suitable link routes as necessary for the ATM task.	Not applicable to ACP-2017-079; ATS routes are not part of the proposal. The proposal is for a suitable airspace reservation of defined dimensions to ensure the safety of other airspace users from SaxaVord launch activities and *vice versa*.
c	All new routes should be designed to accommodate P-RNAV navigational requirements.	Not applicable to ACP-2017-079; there is no requirement to accommodate P-RNAV navigational requirements. The proposal is for a suitable airspace reservation of defined dimensions to ensure the safety of other airspace users from SaxaVord launch activities and *vice versa*.

Table 6 - Airspace & Infrastructure - ATS route Requirements

Airspace & Infrastructure - Terminal Airspace Requirements

54. SaxaVord's assessment of Airspace & Infrastructure - Terminal Airspace Requirements for ACP-2017-079 is contained within Table 7Table 4, below.

	Terminal airspace requirements	Evidence of compliance/proposed mitigation
a	The airspace structure shall be of sufficient dimensions to contain appropriate procedures, holding patterns and their associated protected areas.	Not applicable to ACP-2017-079; there are no appropriate procedures, holding patterns and their associated protected areas applicable to the proposed airspace reservation. The proposal is for a suitable airspace reservation of defined dimensions to ensure the safety of other airspace users from SaxaVord launch activities and *vice versa*.
b	There shall be effective integration of departure and arrival routes associated with the airspace structure and linking to designated runways and published instrument approach procedures (IAPs).	Not applicable to ACP-2017-079; there are no departure and arrival routes associated with the airspace structure and no linking to designated runways and published instrument approach procedures (IAPs). The proposal is for a suitable airspace reservation of defined dimensions to ensure the safety of other airspace users from SaxaVord launch activities and *vice versa*.
c	Where possible, there shall be suitable linking routes between the proposed terminal airspace and existing en-route airspace structure.	Not applicable to ACP-2017-079; there is no requirement for linking routes between the proposed terminal airspace and existing en route airspace structure. The proposal is for a suitable airspace reservation of defined dimensions to ensure the safety of other airspace users from SaxaVord launch activities and *vice versa*.
d	The airspace structure shall be designed to ensure that adequate and appropriate terrain clearance can be readily applied within and adjacent to the proposed airspace.	Not applicable to ACP-2017-079; there is no requirement for designing adequate and appropriate terrain clearance. The proposal is for a suitable airspace reservation of defined dimensions to ensure the safety of other airspace users from SaxaVord launch activities and *vice versa*.
e	Suitable arrangements for the control of all classes of aircraft (including transits) operating within or adjacent to the airspace in question, in all meteorological conditions and under all flight rules, shall be in place or will be put into effect by the change sponsor upon implementation of the change in question (if these do not already exist).	Not applicable to ACP-2017-079; there is no requirement to put in place suitable arrangements for the control of all classes of aircraft (including transits) operating within or adjacent to the airspace in question. The proposal is for a suitable airspace reservation of defined dimensions to ensure the safety of other airspace users from SaxaVord launch activities and *vice versa*.
f	The change sponsor shall ensure that sufficient visual reference points are established within or adjacent to the subject airspace to facilitate the effective integration of VFR arrivals, departures and transits of the airspace with IFR traffic.	Not applicable to ACP-2017-079; there is no requirement to establish sufficient visual reference points to facilitate IFR/VFR integration. The proposal is for a suitable airspace reservation of defined dimensions to ensure the safety of other airspace users from SaxaVord launch activities and *vice versa*.

	Terminal airspace requirements	Evidence of compliance/proposed mitigation
g	There shall be suitable availability of radar control facilities.	Not applicable to ACP-2017-079; there is no requirement for radar control facilities. The proposal is for a suitable airspace reservation of defined dimensions to ensure the safety of other airspace users from SaxaVord launch activities and *vice versa*.
h	The change sponsor shall, upon implementation of any airspace change, devise the means of gathering (if these do not already exist) and of maintaining statistics on the number of aircraft transiting the airspace in question. Similarly, the change sponsor shall maintain records on the numbers of aircraft refused permission to transit the airspace in question, and the reasons why. The change sponsor should note that such records would enable ATS managers to plan staffing requirements necessary to effectively manage the airspace under their control.	Not applicable to ACP-2017-079. When activated, the purpose of the airspace reservation is to ensure safety by exclusion; as such, and except for those specific prescribed conditions in the relevant LOAs/MOUs, there will be no requirement to ensure that prescribed separation can be maintained between aircraft within the airspace structure and safe management of interfaces with other airspace structures. Thus, there is no requirement for maintaining statistics on the number of aircraft transiting the airspace for ATM staffing requirement purposes. If the application is successful, however, SaxaVord acknowledges that there might be specific data capture requirements associated with Stage 7 activities, for example, maintaining a record of the number of instances requests were made by the relevant parties to transit the activated airspace under the prescribed conditions within an extant LOA/MOU.
i	All new procedures should, wherever possible, incorporate Continuous Descent Approach (CDA) profiles after aircraft leave the holding facility associated with that procedure.	Not applicable to ACP-2017-079; there are no holding procedures and no requirements for CDA profiles. The proposal is for a suitable airspace reservation of defined dimensions to ensure the safety of other airspace users from SaxaVord launch activities and *vice versa*.

Table 7 - Airspace & Infrastructure - Terminal Airspace Requirements

Airspace & Infrastructure - Off-route Airspace Requirements

55. SaxaVord's assessment of Airspace & Infrastructure - Off-route Airspace Requirements for ACP-2017-079 is contained within Table 8Table 4, below.

	Off-route airspace requirements	Evidence of compliance/proposed mitigation
a	If the new structure lies close to another airspace structure or overlaps an associated airspace structure, the need for operating agreements shall be considered.	LOAs and MOUs are summarised at Annex B, Table 10. Copies of signed and emergent LOAs/MOUs are provided at Annex B, Appendices 1-5. As indicated at Table 10, the potential requirement for 3 further LOAs/MOUs is being discussed with the relevant parties.
b	Should there be any other aviation activity (military low flying, gliding, parachuting, microlight site etc) in the vicinity of the new airspace structure and no suitable operating agreements or air traffic control procedures can be devised, the change sponsor shall act to resolve any conflicting interests.	LOAs and MOUs are summarised at Annex B, Table 10. Copies of signed and emergent LOAs/MOUs are provided at Annex B, Appendices 1-5. As indicated at Table 10, the potential requirement for 3 further LOAs/MOUs is being discussed with the relevant parties.

Table 8 - Airspace & Infrastructure - Off-route Airspace Requirements

14. ENVIRONMENTAL ASSESSMENT

56. SaxaVord's summary Environmental Assessment for ACP-2017-079 is contained within Table 9Table 4, below.

	Theme	Content	Evidence of compliance/ proposed mitigation
a	WebTAG analysis.	Output and conclusions of the analysis (if not already provided elsewhere in the proposal).	Monetisation by appropriate qualitative and quantitative methods are detailed further in the ACP-2017-079 Stage 3 Full Options Appraisal; the corresponding elements are reproduced at Annexes A and C.
b	Assessment of noise impacts (Level 1/M1 proposals only).	Consideration of noise impacts, and where appropriate the related qualitative and/or quantitative analysis, including whether the anticipated noise impact meets the criteria for a proposal to be called-in by the Secretary of State (paragraph 5(c) of Direction 6 of the Air Navigation Directions 2017). If the change sponsor expects that there will be no noise impacts, the rationale must be explained.	The direct impact of noise due to vertical launch spaceflight activities at SaxaVord Spaceport was assessed in SaxaVord Spaceport AEE V2.1 Assessment of Environmental Effects dated 30/09/22 submitted to the CAA as part of Space Industry Act 2018 licensing activities. Volume II Chapter 8[24] considers noise and vibration. In addition, Volume IV Appendix 8.1 contains a copy of a report commissioned by SaxaVord from Blue Ridge Research and Consulting LLC (BRRC) titled "Noise Study for Launch Vehicle Operations at Shetland Space Centre" dated 02/10/20. Assessment of noise impacts ("Direct" and "Indirect") are detailed further in the ACP-2017-079 Stage 3 Full Options Appraisal; the corresponding elements are reproduced at Annexes A and C. Stage 3 stakeholder consultation responses prompted no subsequent design iteration. The anticipated noise impact does not meet the criteria for a proposal to be called-in by the Secretary of State (paragraph 5(c) of Direction 6 of the Air Navigation Directions 2017).
c	Assessment of CO2 emissions.	Consideration of the impacts on CO2 emissions, and where appropriate the related qualitative and/or quantitative analysis. If the change sponsor expects that there will be no impact on CO2 emissions impacts, the rationale must be explained.	Assessment of CO2 emissions are detailed in the ACP-2017-079 Stage 3 Full Options Appraisal, the corresponding sections of which have been reproduced at Annexes A and C, below. Stage 3 stakeholder consultation responses prompted no subsequent design iteration.

24. ITPEnergised (2022), "*SaxaVord Spaceport (ITPEnergised) AEE*", V2.1, dated 30 Sep 22. Chapter 8 (Noise and Vibration) of the AEE document has been extracted and submitted to CAA to support the ACP-2017-079 Stage 2 submission.

	Theme	Content	Evidence of compliance/ proposed mitigation
d	Assessment of local air quality (Level 1/M1 proposals only).	Consideration of the impacts on local air quality, and where appropriate the related qualitative and/or quantitative analysis. If the change sponsor expects that there will be no impact on local air quality, the rationale must be explained.	Assessment of local air quality is detailed in the ACP-2017-079 Stage 3 Full Options Appraisal, the corresponding sections of which have been reproduced at Annexes A and C, below. Stage 3 stakeholder consultation responses prompted no subsequent design iteration.
e	Assessment of impacts upon tranquillity (Level 1/M1 proposals only).	Consideration of any impact upon tranquillity, notably on Areas of Outstanding Natural Beauty or National Parks, and where appropriate the related qualitative and/or quantitative analysis. If the change sponsor expects that here will be no tranquillity impacts, the rationale must be explained.	Assessment of any impact upon tranquillity, notably on Areas of Outstanding Natural Beauty or National Parks is detailed in the ACP-2017-079 Stage 3 Full Options Appraisal, the corresponding sections of which have been reproduced at Annexes A and C, below. Stage 3 stakeholder consultation responses prompted no subsequent design iteration.
f	Operational diagrams.	Any operational diagrams that have been used in the consultation to illustrate and aid understanding of environmental impacts must be provided.	Diagrams used to illustrate and aid understanding of environmental impacts were provided in the Stage 3 consultation materials[25] and Full Options Appraisal. The corresponding sections of the Full Options Appraisal have been reproduced at Annexes A and C, below. Stage 3 stakeholder consultation responses prompted no subsequent design iteration.
g	Traffic forecasts.	10-year traffic forecasts, from the anticipated date of implementation, must be provided (if not already provided elsewhere in the proposal)	A 10-year air traffic forecast is offered in the ACP-2017-079 Stage 3 Full Options Appraisal, the corresponding sections of which have been reproduced at Annex A. Stage 3 stakeholder consultation responses prompted no subsequent design iteration.
h	Summary of environmental impacts and conclusions.	A summary of all of the environmental impacts detailed above plus the change sponsor's conclusions on those impacts.	SaxaVord considers the environmental impacts of the proposal as summarised in this table to be acceptable.

Table 9 - Summary Environmental Assessment

25. *"SaxaVord Spaceport ACP-2017-079 CAP1616 Stage 3 - CONSULT Stakeholder Materials (V3.2)"*, Slides 43, 45 and 46 (online), accessed on 23 Jun 23.

15. CONCLUSION

57. The UK Space Innovation and Growth Strategy (IGS) sets out ambitious targets for the growth of the UK space sector, with 'Access to Space' being a key IGS theme. The UK has clearly stated its ambition to become a launching state, with the long term [*sic*] goal of being able to support suborbital operations and orbital delivery of small satellites.26

58. Shetland Space Centre Limited (SaxaVord Spaceport) seeks to conduct vertical launch operations for orbital and sub-orbital activities from SaxaVord Spaceport on Lamba Ness, Unst. A suitable airspace reservation of defined dimensions is required to ensure the safety of other airspace users from SaxaVord launch activities and *vice versa*. SaxaVord initiated its Airspace Change Proposal (ACP) in 2017.

59. Unlike an airspace change at a UK aerodrome, there is no "current day" operation for the SaxaVord Spaceport to refer to as a baseline; therefore, any "baseline" position would be the prevailing air traffic situation at a given time. SaxaVord analysed a year's ADS-B surveillance data to establish a pre-COVID-19 "baseline" traffic assessment, enabling the identification of the potential impacts of SaxaVord's proposed airspace design on the ATM/airspace network and its users. A peak day and hour were identified, during which 12 flights could be impacted by the activation of the proposed airspace design.

60. The Stage 3 Consultation Report summarises consultation responses, categorisation and SaxaVord associated analyses. Whilst responses and feedback prompted no changes or revisions to the proposed airspace design, "notification and coordination" associated with the activation and tactical management of access to the activated airspace was a key theme and identified the potential need for a further 3 operating agreements with local aviation stakeholders in the vicinity of the spaceport, which are being progressed proactively. Indeed, this facet of managing the operation of the proposed airspace and its activation has been a consistent focus for SaxaVord throughout the ACP process.

61. SaxaVord's Full options Appraisal concluded that the wider ATM/airspace network and its users could incorporate the unmitigated activation of Design Option 3 with minimal/negligible impact on the baseline prevailing traffic scenario. Moreover, the segmented airspace design would enable a reduced volume to be activated, commensurate with the launch profile and LV requirements; in turn, this could reduce impact further.

62. Accordingly, SaxaVord's ACP-2017-079 Design Option 3 is submitted to CAA.

ANNEXES

A. Extract From ACP-2017-079 Stage 3 Full Options Appraisal - Full Options Appraisal Requirements.
B. ACP-2017-079 Letters of Agreement and Memoranda of Understanding.
C. Extract From ACP-2017-079 Stage 3 Full Options Appraisal - Appendix 1.
D. ACP-2017-079 CAA Aeronautical Data Approval Template.

26. Demios Space UK Ltd, "*Sceptre Report*" (2017), Page 2 ("*Executive Summary*") (online). Accessed on 27 Jun 23.

Annex A to
ACP-2017-079 Stage 4 Submission
Dated 7 Jul 23

EXTRACT FROM ACP-2017-079 STAGE 3 FULL OPTIONS APPRAISAL

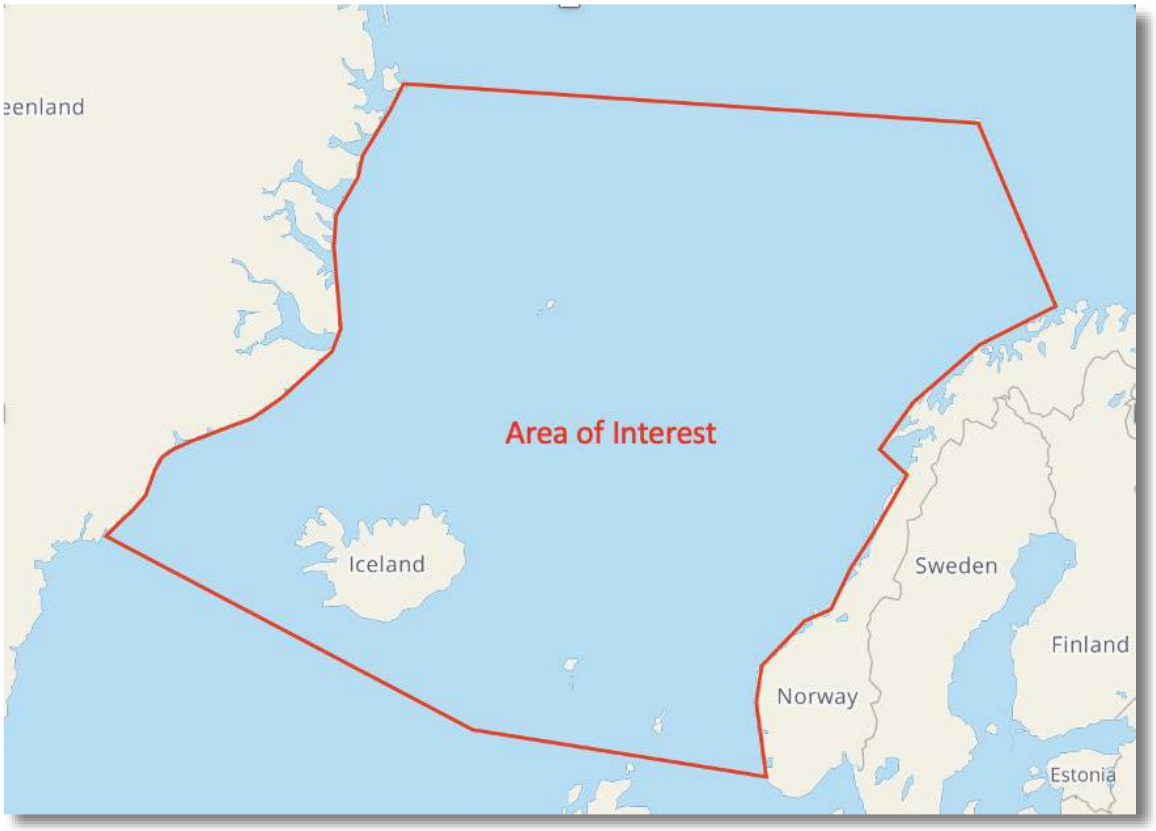
"Full Options Appraisal Requirements

15. *"Current Day" Operations.* As outlined earlier at Para 2, above, unlike an airspace change at a UK aerodrome, there is no current day operation to refer to as an operational baseline; thus, there is no SaxaVord operational *status quo* to maintain. The baseline "position", therefore, is the identified prevailing traffic/network situation at a given time; SaxaVord assessed Design Option 3 against the baseline scenario (i.e. the extant aviation position).

16. *Baseline Position.* As detailed at Stage 2, SaxaVord conducted a baseline scenario traffic assessment relative to the potential traffic impacted by the activation of the proposed airspace designs for ACP-2017-079. This assessment and associated analyses were revisited for Design Option 3.

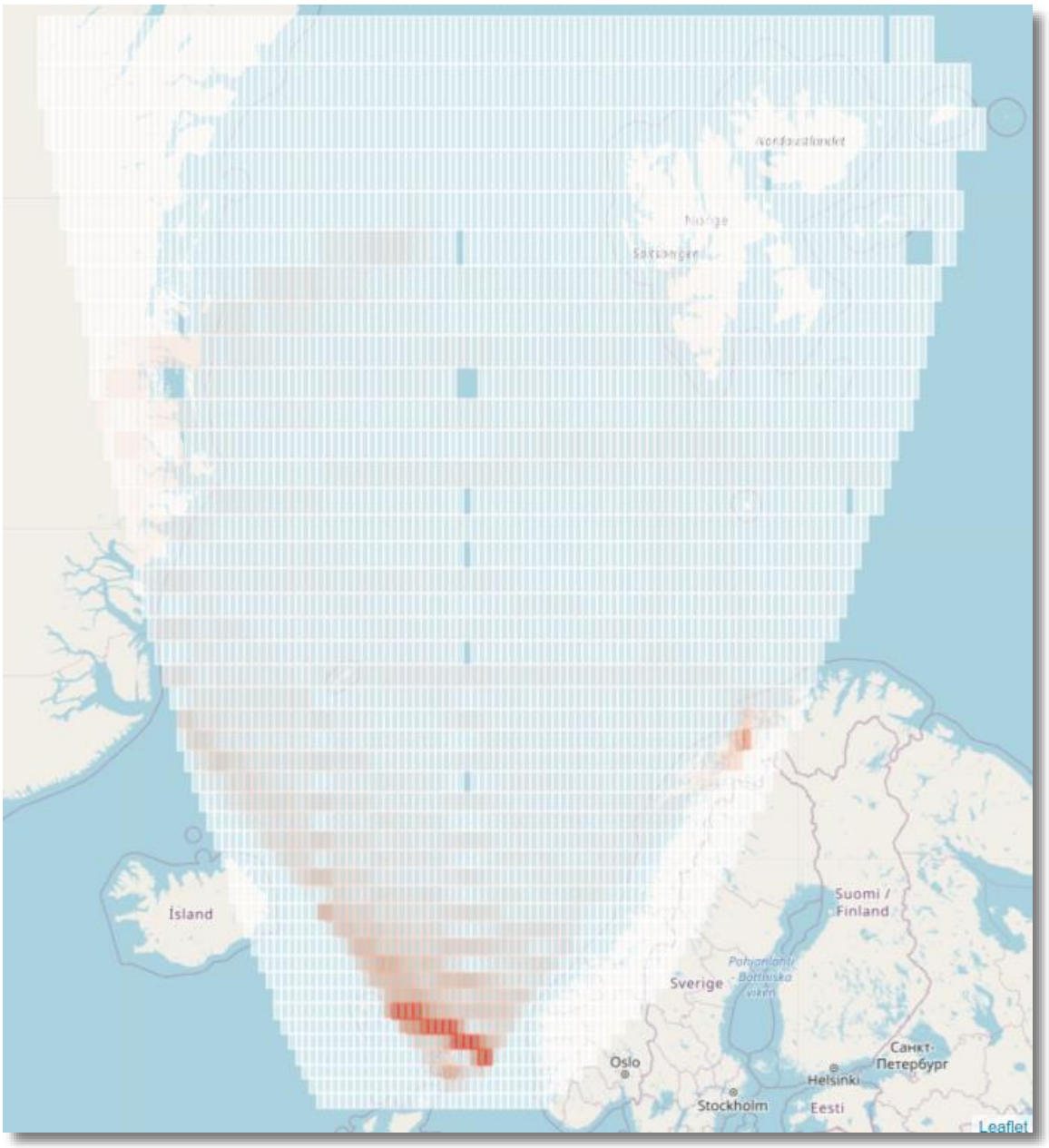
17. *Approach.* The airspace analysis approach was to apply a macro air traffic flow perspective to various micro assessments.

18. *Objective.* The objective of the traffic assessment and analysis was to obtain an appreciation of the lifecycle of air traffic movements in relation to the anticipated launch operations trajectories from the SaxaVord site, as defined by the supplied Area of Interest (AOI) (Figure 3); this traffic capture was chosen to be deliberately larger than the Range Analysis AOI (Figure 4).



Source: AVISU

Figure 3 - Range Licence AOI



Source: AVISU (Subject to ITAR)

Figure 4 - ADS-B 2019 AOI Traffic Heat Map

Traffic Sample Data

19. The assessment obtained a year's ADS-B surveillance data[27] for the period January to December 2019, selected specifically for pre-COVID-19 traffic levels. The data covers all three ADS-B out transponder versions (0, 1 and 2). Additionally, Eurocontrol traffic monitoring data shows that, overall, the aircraft fleet operating within the EU with at least one of these ADS-B versions is approximately 90% of all its monitored traffic. This percentage will be significantly higher in the SaxaVord range AOI (Figure 3), given that Eurocontrol monitoring includes traffic operating at low levels across the

27. The ADS-B data and, therefore, source are subject to International Trade in Arms Regulation (ITAR); as such, the source cannot be divulged in this document.

continent. Furthermore, related discussions with NATS confirmed the low incidence of visual flight rules (VFR)/general aviation (GA) traffic. As such, the data sample can be seen to be of sufficiently high fidelity for this assessment's purposes.

20. Over the year, approximately 30,000 aircraft transited the AOI (Figure 4), predominantly in an east-west orientation. Unsurprisingly, the traffic analysis identified seasonal variations, i.e. higher traffic levels in summer months and reduced levels in winter months.[28]

21. Within the sample traffic data, the peak day was identified as 2 Aug 19, when a total of 191 aircraft passed through the larger (Figure 3) AOI; peak periods were observed between 1300 and 1500 hrs, when 28 aircraft per hour passed through the (Figure 3) AOI.

22. Continuing to consider the peak day, Design Option 3 could be seen to impact a maximum of 12 flights per hour of activation.

Design Option 3 Traffic Impact Assessment

23. *Design Option 3 Area of Interest.* The Design Option 3 volume is significantly smaller when compared with the original (and larger) traffic assessment area, as illustrated in Figure 5, below; Design Option 3 is depicted in the reddened area of the figure. Traffic re-route impact assessment focuses on those flights transiting the reddened area of Figure 5.

28. The analysis of the traffic sample data was conducted using AVISU's AVISIM™ analytics tool (Avisim - Simulation and Analytics - AVISU).

Source: AVISU

Figure 5 - Design Option 3 Area (in Red) Compared With the Traffic Assessment Area (in White)

24. *Re-route Extension and Emission Impact from Activation of the Proposed Airspace.* The traffic patterns of other airspace users were analysed against an anticipated airspace activation period of one hour. Airspace activation durations will vary based on the maturity of the LV and the trajectory and orbital requirements. The peak day was identified as 13 Aug 19 and a peak hour of 1300-1400 UTC was selected for analysis, during which 12 flights could potentially be impacted. The data indicated that aircraft currently plan longer distances than the great circles (given SaxaVord's AOI) most likely due to wind effects (i.e. normally to avoid headwinds). All traffic was observed to be travelling broadly east-west and is depicted in Figure 6, below.[29]

Source: AVISU

Figure 6 - Potential Peak Day Peak Hour Traffic Impacted By Airspace Activation - Original Route Segments

25. *Re-route Methodology.* The following simple re-route methodology was applied: entry and exit points within the assessment area are maintained (see also Para 25, below); flights that entered the assessment area south of the latitude of SaxaVord Spaceport launch site were re-routed to avoid the airspace design to the south, those entering north of the launch site were re-routed to the north of the airspace design. Only one aircraft was routed to the north. Re-routed traffic patterns of other airspace user are depicted in Figure 7, below.[30]

29. CAP1616, Page 166, Para B57 "Operational Diagrams".
30. *ibid.*

Source: AVISU

Figure 7 - Potential Peak Day Peak Hour Traffic Impacted By Activation - Simulated Re-route Segments

26. The methodology above offers a simplification of re-routing to avoid an airspace reservation; the reality, however, would be notably different. Undoubtedly, flights' routes would be planned on the ground, prior to departure, to accommodate known airspace reservations and constraints across the whole route of the flights' routes.

27. In addition, the methodology offered here reflects a more "tactical" management of the flow within the Eurocontrol airspace/ATM network, i.e. on the day of operation of the network, *vice* the "strategic" and "pre-tactical" aspects of network flow management. These latter activities seek to resolve network demand and capacity imbalances (between Day-7 and Day-1) and minimise air navigation service providers' (ANSPs') tactical management of airspace reservations.

28. The computations associated with a more detailed analysis are too numerate and, undoubtedly, would be influenced by - inter alia - the prevailing meteorological conditions, ATM route loading and airline routing policies/strategies.

29. *Analysis of Re-routed Traffic.* For the peak hour of the peak day identified from the data sample, Table 1, below, offers a comparison between the baseline original route through the wider AOI and a potential and unmitigated re-route; the latter is based on the methodology cited above.

Ser	Callsign	Original Route (km)	Re-route (km)	Route Δ (km)
1	PCH893	1116	1106	-10
2	JET1	1321	1325	4
3	UAL125	1210	1241	31
4	SWR40	1272	1266	-6
5	TSC701	1066	1047	-19
6	SWR38	1275	1277	2
7	AAL759	1268	1284	16
8	RJA12B	1063	1054	-9
9	N324CH	1054	1054	0
10	ACA845	1376	1370	-6
11	ACA891	1116	1100	-16
12	UAL47	1333	1358	25
			Total Difference	+12km

Table 1 - 13 Aug 19 Peak Day, Peak Hour Traffic Re-route Calculation

Table 1 concludes that the total re-route for the traffic sample of 12 flights is a cumulative additional 12km; however, analysing the most impacted flight offered a scale of the greatest potential impact at a peak period within that portion of the network.

30. The most impacted flight can be seen to be UAL125 (Athens to Newark International), at Serial 3 in Table 1, above, which could be subjected to a 31km route extension. The flight distance from Athens to Newark is approximately 8000km; an extension of 31km would, therefore, correspond to an increase of 0.39%, which could be considered negligible.

31. Were a 31km extension to be applied to ALL flights in the sample, this could result in a total route extension of 372km for the impacted flights. This working assumption is explored further, below.

32. It is also important to note that the data in Table 1 assumes a full one-hour airspace volume activation and makes no provision for either a tactical hand-back of the airspace to the network, which in turn would allow for ANSPs to apply a subsequent tactical re-route, or a re-route prior to the flight entering the AOI, potentially reducing extensions to impacted flights' tracks.[31]

33. *Potential Fuel Burn and Emissions Impact.* Analysis shows that, today, airlines often adopt slightly longer routes for wind, which may result in faster flight times. SaxaVord is unable to predict business decisions on airlines' routing as these are firmly the purview of individual operators.

34. The demonstrable negligible re-route impacts, therefore, show that the activation of Design Option 3 does not have a significant impact on fuel burn and greenhouse gas emissions, as, in some cases, the potential re-route could produce either a shorter or equivalent flight distance.

31. The subject of tactical notification and coordination procedures is an ongoing topic of discussion associated with LOAs and MOUs between SaxaVord and the relevant national and international parties.

35. The most impacted flight profile in the data sample from Table 1, above, was UAL125 from Athens to Newark International, a flight distance of 7952km. Using ICAO's Carbon Emissions Calculator[32], the representative aircraft type for this journey is a Boeing B777, or B777-300ER; on this route, the total fuel burn for this flight is offered as 76,399.60kg. This equates to an average fuel burn rate of 9.61kg/km.[33]

36. An accepted industry measure of carbon dioxide equivalent (CO2e) per kg of aviation fuel burned is 3.18kg of CO2e per kg of fuel.[34] The Athens-Newark flight of 7952km, therefore, produces 242,950.728kgs of CO2e, which equates to 30.55kgs[35] of CO2e per km. Thus, a 31km extension of this flight's route could produce an additional 947.12kg[36] of CO2e from an additional fuel burn of 297.84kg.[37]

37. The 947.12kg increase in CO2e associated with a re-route of 31km is a 0.39% (unmitigated) increase in the flight's overall CO2e. Similarly, the increase in fuel burn for the total route is 0.39%.

Annual Traffic Re-route, Fuel Burn and CO2e Impact Assessment

38. An annual traffic re-route impact was derived to quantify a worst-case scenario associated with the activation of Design Option 3.

39. *Assumptions.* To quantify an annual re-route **maximum** impact, the following assumptions have been made (see also Paras 25, 26 and 41):

- Launch Window Duration. The launch window duration is one hour.
- Traffic Sample. The traffic sample is 12 flights, highlighted at Table 1, above.
- Flight Distance. The flight distance for each flight is 8000km.
- CO2e per kg of Fuel. Flights will emit 3.18kg CO2e per kg of fuel.
- Re-route Extension. A 31km route extension was applied to ALL flights.
- No. of Instances. The no. of instances of activation is 30 times (i.e. SaxaVord launches) per annum.

32. ICAO Carbon Emissions Calculator (online). Accessed on 14 Mar 23.
33. 76,399.60kg divided by 7952km and reduced to 2 decimal places (dp).
34. CAP1616a, Page 24, Para 1.8.
35. 76,399.60kg divided by 7952km, multiplied by 3.18kg of CO2e/kg fuel and reduced to 2 dp.
36. 30.55 (2dp) CO2e per km multiple by 31 additional km.
37. 9.61 (2dp) kg fuel per km multiplied by 13 additional km.

40. *Annual Re-route, Fuel Burn and CO2e Impact Calculations*. The analysis of potential impacts and the calculations is offered in Table 2, below.

No Flights Per Peak Hour	12			
Flight Distance (km)	8000			km
Total Baseline Distance Flown (km) Per Peak Hour		96,000		km
CO2e (kg)/kg of Fuel	3.18			kg
Fuel Burn(kg)/km	9.61			kg
CO2e (kg)/km	30.55			kg
Total Baseline Fuel Burn (tonnes) Per Peak Hour		922.33		tonnes
Total Baseline CO2e (tonnes) Per Peak Hour		2,933		tonnes
No of Instances Per Annum	30			
Total Baseline Distance Flown (km) Per Annum			*2,880,000*	km
Total Baseline Fuel Burn (tonnes) Per Annum			*27,670*	tonnes
Total Baseline CO2e (tonnes) Per Annum			*87,990*	tonnes
Re-route per Flight (km)	31			
Potential Re-route Distance (km) Per Peak Hour		372		km
Potential Re-route CO2e (tonnes) Per Peak Hour		11.37		tonnes
Potential Re-route Distance (km) Per Annum			*11,160*	km
Potential Re-route Fuel Burn (tonnes) Per Annum			*107*	tonnes
Potential Re-route CO2e (tonnes) Per Annum			*341*	tonnes
Potential Total Distance Flown (km)			*2,891,160*	km
Potential Impacted CO2e (tonnes)			*88,331*	tonnes

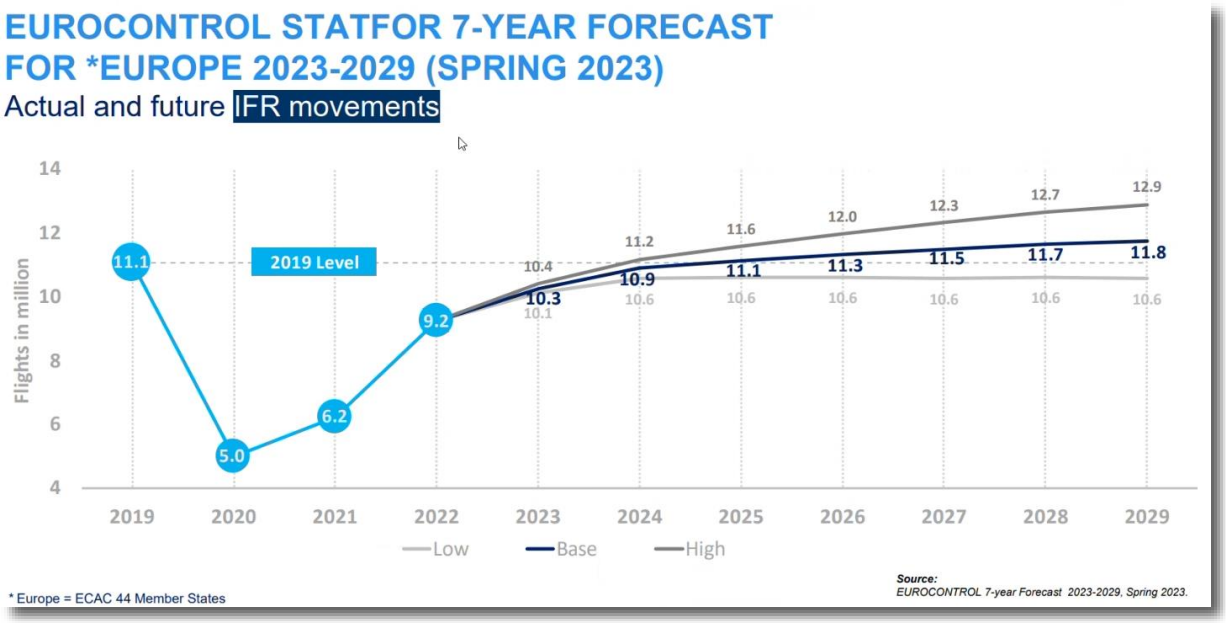
Table 2 - Traffic Re-route, Fuel Burn and CO2e Impact Calculations

41. Table 2, above, demonstrates that the activation of Design Option 3 at the peak hour of the peak day in the traffic sample on 30 instances (i.e. SaxaVord launches) per annum could precipitate an impact of an additional 11,160km flight distance, an additional 107tonnes of fuel burn and an additional 341tonnes of CO2e to the 12 flights in the exemplar instance at Table 1. These figures must, however, be viewed in comparison with their respective baseline calculations, 2,880,000km, 27,670tonnes and 87,990tonnes, respectively; the potential impact of a worst-case scenario represents an (unmitigated) increase of 0.39% in flight distance, fuel burn and CO2e.

42. Most importantly, these calculations do not consider Eurocontrol modelling and the identification of suitable launch windows to minimise impact on the airspace/ATM network, while satisfying specific launch orbit requirements. These latter activities could do much to further reduce the calculated impacts of the proposed airspace activation on the wider airspace network.

Forecast Traffic Levels

43. An extract from Eurocontrol's Traffic Forecast Update for Europe 2023-2029, dated Spring 2023, is offered at Figure 8, below.



Source: Eurocontrol

Figure 8 - Extract from Eurocontrol 7-year Forecast for Europe 2023-2029

44. *Forecast Assumptions.* For this element of the traffic assessment and analysis, the following assumptions have been made:

- The 12 impacted flights, as set out in Table 1, above, is the datum.
- The "Base" forecast (depicted in dark blue in Figure 8, above) is the measure for extrapolating data to 2028.
- The percentage growth of the Base forecast from 2024 to 2027 is +2%; thereafter, it reduces to +1%, annually. Accordingly, and in the absence of empirical data, when extrapolating the Base forecast beyond 2029, +1% is assumed to be the annual forecast growth for the years 2030-2034.
- Given the infinite combinations of airspace activation time(s) and routes/destinations of the prevailing flights potentially impacted, the traffic sample in Table 1, above, applies across all years in Table 3, below, which illustrates 10 years from the proposed implementation of the airspace change.
- Forecast meteorological conditions cannot be considered in this analysis.

45. *Forecast Analysis.* Eurocontrol do not forecast a return to 2019 Base traffic levels until 2025; accordingly, the assumed datum of 12 flights is an overestimation for 2022-2024 (incl.).

46. The assumed datum and application of percentage variance by year is set out in Table 3, below, and accompanied by an estimate on the potential number of flights impacted by the airspace activation. Although the Base forecast is assumed (Figure 8 in dark blue), Low (Figure 8 in light grey) and High (Figure 8 in dark grey) scenarios are offered for comparison.

47. Annual percentage growth for the Low forecast was +4% (from the 2019 datum) in 2023 and +1% in 2024, thereafter, reducing to 0%; accordingly, 0% is used to extrapolate beyond 2029. Annual percentage growth for the High forecasts were +8% (from the 2019 datum) in 2023, +4% in 2024, +3% in 2025, 2026, 2027 and 2028, reducing to +2% in 2029; accordingly, this latter growth figure was extrapolated beyond 2029. In addition, numbers of impacted flights have been rounded up to ensure that a most limiting figure is shown.

Ser	Year	2022 Datum	Traffic Variance (%) (From Figure 8			Potential Impacted Flights (Rounded Up to Nearest Whole No)		
			Low	Base	High	Low	Base	High
1	2019		-	-	-	-	12	-
2	2020		-55	-55	-55	-	12	-
3	2021		-44	-44	-44	-	12	-
4	2022		-17	-17	-17	-	12	-
5	2023	12	-9	-7	-7	-	12	12
6	2024		-5	-2	+1	-	12	13
7	2025		-4	0	+5	12	12	13
8	2026		-4	+2	+8	12	13	13
9	2027		-4	+4	+11	12	13	14
10	2028		-4	+5	+14	12	13	14
11	*2029*		*-4*	*+6*	*+16*	*12*	*13*	*14*
12	*2030*		*-4*	*+7*	*+18*	*12*	*13*	*15*
13	*2031*		*-4*	*+8*	*+20*	*12*	*13*	*15*
14	*2032*		*-4*	*+9*	*+22*	*12*	*14*	*15*
15	*2033*		*-4*	*+10*	*+24*	*12*	*14*	*15*
16	*2034*		*-4*	*+11*	*+26*	*12*	*14*	*16*

Table 3 - Variance in Forecast Traffic Levels and Potential Impacted Flights

48. Drawing upon Eurocontrol's traffic forecast at Figure 8 and the analysis offered at Table 3, it can be shown that there is not a marked increase in the number of potential flights impacted by the activation of the Design Option 3. A further 2 flights potentially impacted in 10 years' time, whilst an increase in relative terms, is not considered a significant absolute increase.

49. Additionally, the analysis assumed the most limiting (i.e. greatest) volume of Design Option 3. It could, therefore, be posited that a reduced airspace volume of Design Option 3, tailored to the specific LV, could either impact a smaller number of flights, or produce a lesser impact on the same number of flights.

50. Finally, the analysis here does not consider the benefit of Eurocontrol modelling capabilities and suitable launch window selection, which would seek to identify and select the appropriate launch window to minimise impact on the airspace/ATM network and its users, while satisfying specific launch orbit requirements.

Network Traffic Analysis Summary

51. SaxaVord analysed a year's ADS-B surveillance data to establish a pre-COVID-19 baseline traffic assessment, thereby enabling the identification of the potential impacts of SaxaVord's Design Option 3 options on the ATM/airspace network and its users. The AOIs considered macro and micro levels of airspace volumes, to enable context and comparisons to be drawn and identify the maximum

potential number of flights that could be impacted were Design Option 3 to be activated. In turn, this enabled the subsequent analyses of the potential impacts of re-routing flights to avoid the airspace reservation, consider the associated impacts on individual flights routes (both positive and negative) and offer an initial assessment on environmental considerations (i.e. CO2e).

52. A peak day and hour were identified and, during that epoch, 12 flights could be impacted by the activation of Design Option 3; using Eurocontrol traffic forecast data, this could increase to 14 flights in 10 years.

53. Flight distances were observed to be impacted by between -19 and +31km. Despite an observed cumulative variation of +12km across the whole flight sample, SaxaVord assumed an absolute worst-case scenario of an additional 31km for each flight. Extrapolating this extended flight distance across 12 flights and 30 instances (i.e. SaxaVord launches), the annual impacts for flight distance, fuel burn and CO2e could be shown to increase by 11,160km, 107tonnes and 341tonnes, respectively, representing a 0.39% (unmitigated) increase in all metrics above the measured baseline calculations.

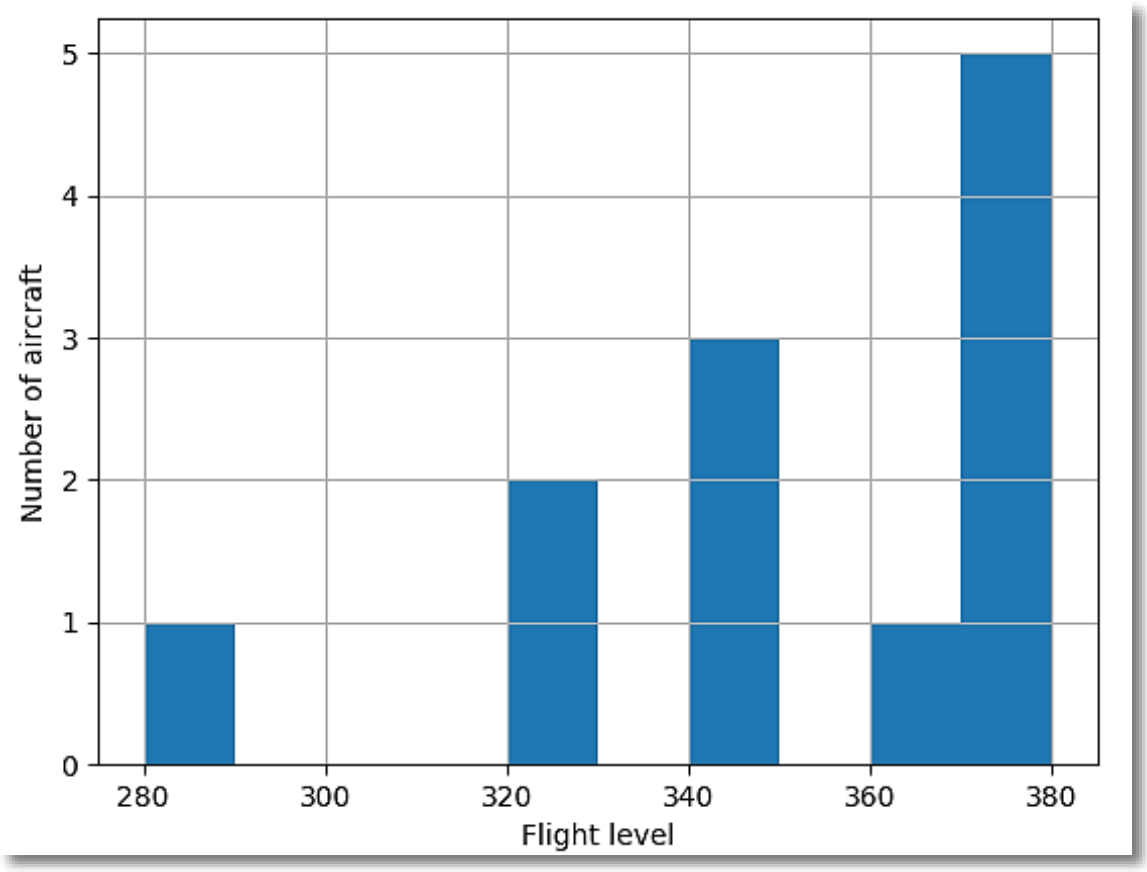
54. The analysis did not consider Eurocontrol modelling and the identification of suitable launch window that sought to select the most appropriate launch window to minimise impact on the airspace/ATM network, while satisfying specific launch orbit requirements. SaxaVord views these latter activities as key mitigation measures in minimising impact on the network.

55. SaxaVord, therefore, concludes that, even in a most limiting case, the wider ATM/airspace network and its users could incorporate the unmitigated activation of the whole of Design Option 3 with minimal/negligible impact on the baseline prevailing traffic scenario. Moreover, Design Option 3 would enable a reduced volume to be activated, commensurate with the launch profile and LV requirements; in turn, this could reduce impact further.

Additional Assessment Criteria

56. *Indirect Noise Impact.* For the sample peak day and hour, (i.e. 13 Aug 19 and 1300-1400UTC), the data shows that there were 12 flights none of which was below FL280. Consequently, there was no indirect noise impact below 7,000ft AMSL.[38]

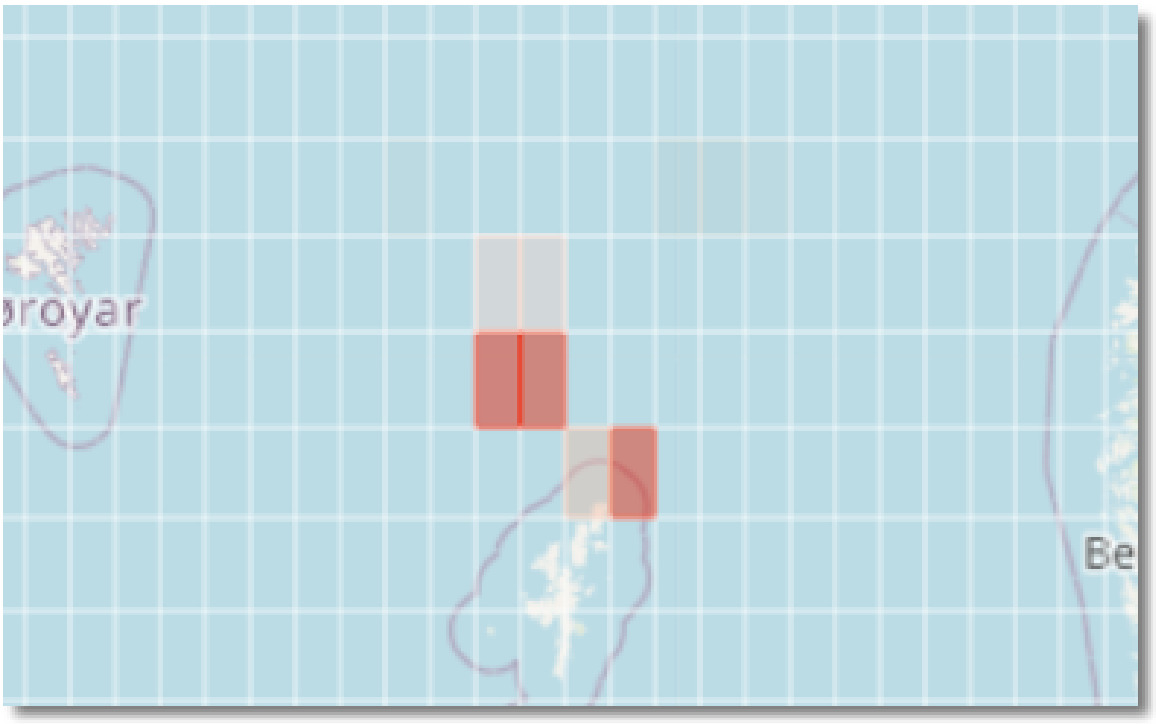
38. CAP1616, Page 26, Table 2, "Level 1" (online). Accessed 3 Jan 23.



Source: AVISU

Figure 9 - Peak Day and Peak Hour traffic Flight Levels

57. When analysing the year's traffic data solely for aircraft operating below 7,000ft AMSL within the Design Option 3 volume, the most impacted day is the 2 Aug 19 with at most 6 low-level aircraft throughput over the 24-hour period (see Figure 10, below).



Source: AVISU

Figure 10 - Traffic Below 7,000ft AMSL

58. When focussing on a single operating hour, at most only 2 aircraft are impacted and these were over the sea.

59. The surveillance data does not have flight plan information on these flights, so a re-route analysis is not possible; however, it is reasonable to assume that these could be local GA aircraft that could adjust their flight profiles and schedules to deconflict with the activation of the Design Option 3 and corresponding aeronautical restriction.

60. Thus, the activation of Design Option 3 is not considered a material change to "routes and/or traffic patterns … below 7,000 feet (above mean sea level)"; similarly, this does not precipitate a corresponding change in either emissions or noise impacts. See Appendix 1.

61. *Stage 3 Safety Statement.* SaxaVord acknowledges that "… there is no requirement for a change sponsor to undertake further safety work at this stage, where a sponsor has done so, it must include that information in the package of consultation documents."[39] The Initial Safety Statement and corresponding analysis provided at Stage 2, therefore, remain extant. Safety in the launch area will be by exclusion.

62. Launch activities by launch operators will be regulated and licenced by the CAA in accordance with the UK SIA 2018 and associated SIR. The flight safety analysis of the individual licenced launch will, therefore, dictate the need for a specific airspace reservation in the launch area. In addition, the design has been informed by representative orbital and suborbital cases that will encompass all anticipated LVs likely to use the SaxaVord launch site.

63. *Other Assessment Criteria*. See Appendix 1 for the assessment of Design Option 3 against Table E2 from CAP1616.

39. CAP1616 Page 47, Para 157.

64. *Monetisation*. Where a metric has been monetised, it should be noted that that the value(s) will be between the extremities of Baseline (i.e. no change) and the most limiting case activation of Design Option 3. Due to the numerous possible combinations of the activation of the airspace design and its impact on the wider ATM/airspace network and its users, it is not possible to monetise and quantify the individual scenarios."

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Annex B to
ACP-2017-079 Stage 4 Submission
Dated 7 Jul 23

ACP-2017-079-RELATED LETTERS OF AGREEMENT AND MEMORANDA OF UNDERSTANDING

Ser	Title	Status	Remarks/Comments.	Location
1	[redacted]	Signed	[redacted]	Appendix 1
2	[redacted]	Awaiting Signature	[redacted]	Appendix 2
3	[redacted]	Under Development	[redacted]	Appendix 3
4	[redacted]	Under Development	[redacted]	Appendix 4
5	[redacted]	Draft	[redacted]	Appendix 5

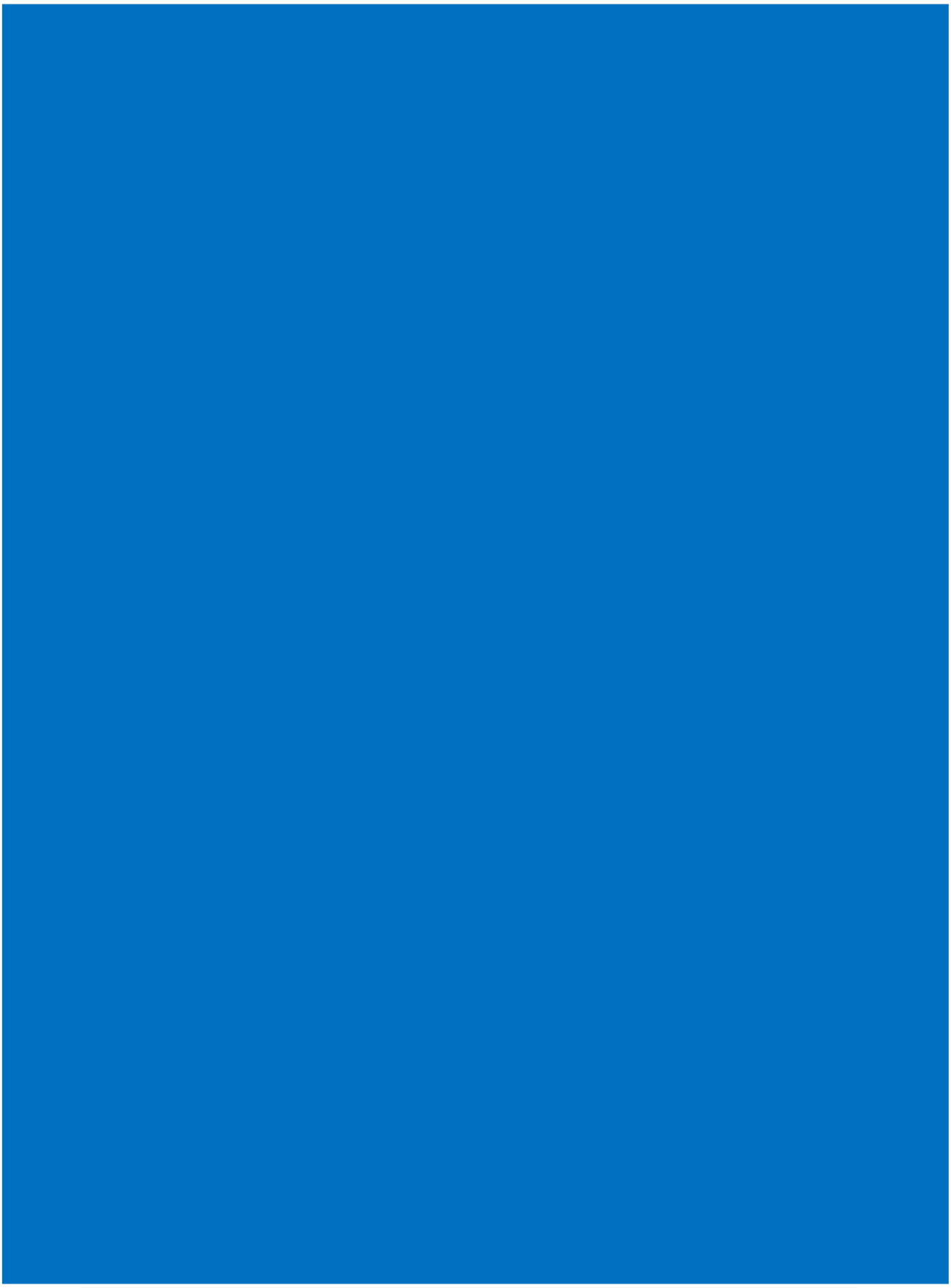
Ser	Title	Status	Remarks/Comments.	Location
6	[redacted]	Under Development	[redacted]	N/A
7	[redacted]	Under Development	[redacted]	N/A
8	[redacted]	Under Development	[redacted]	N/A

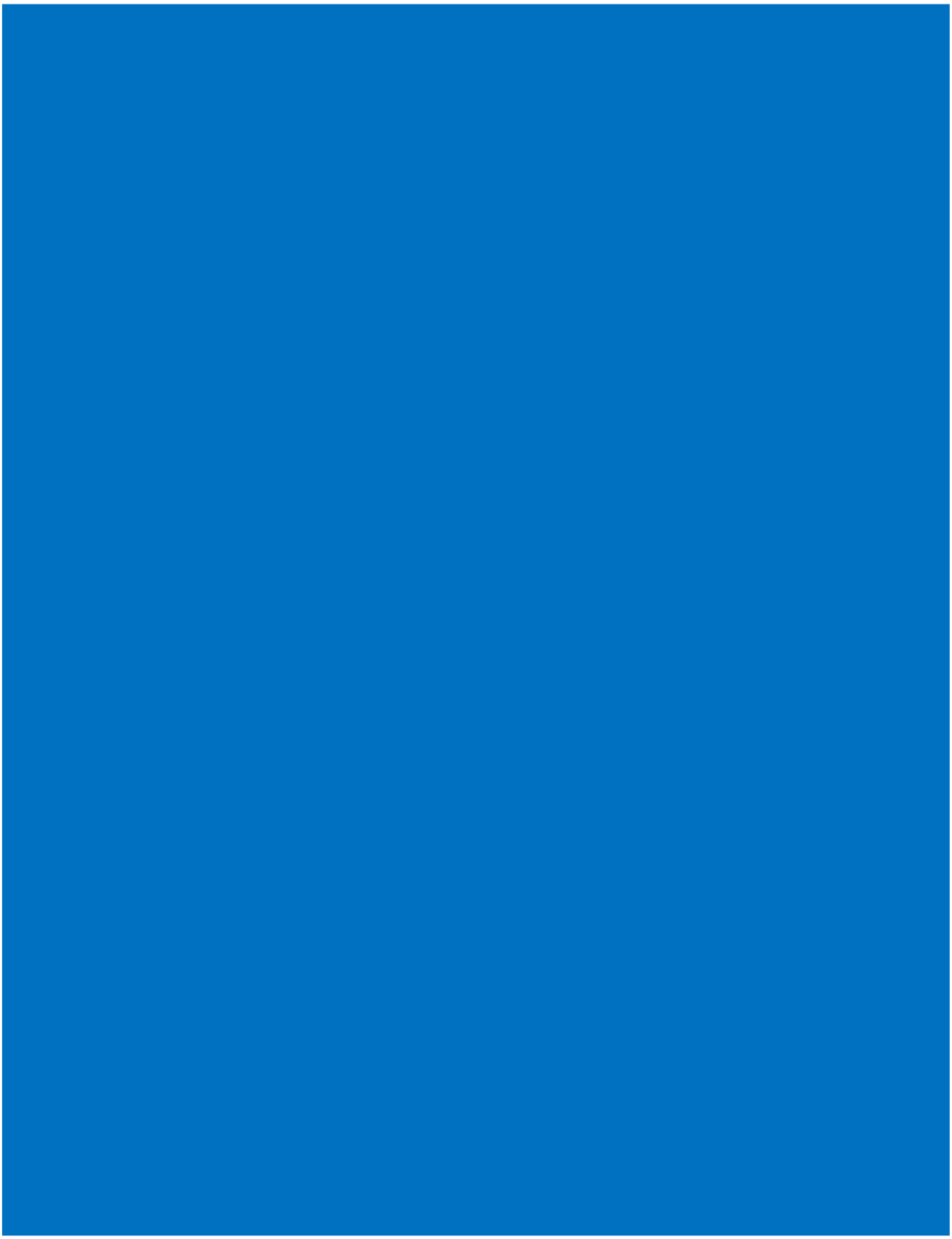
Table 10 - ACP-2017-079 LOA/MOU Summary (as at 7 Jul 23)

Appendices:

1. [redacted]
2.
3.
4.
5.

Appendix 1 to
Annex B to
ACP-2017-079 Stage 4 Submission
Dated 7 Jul 23





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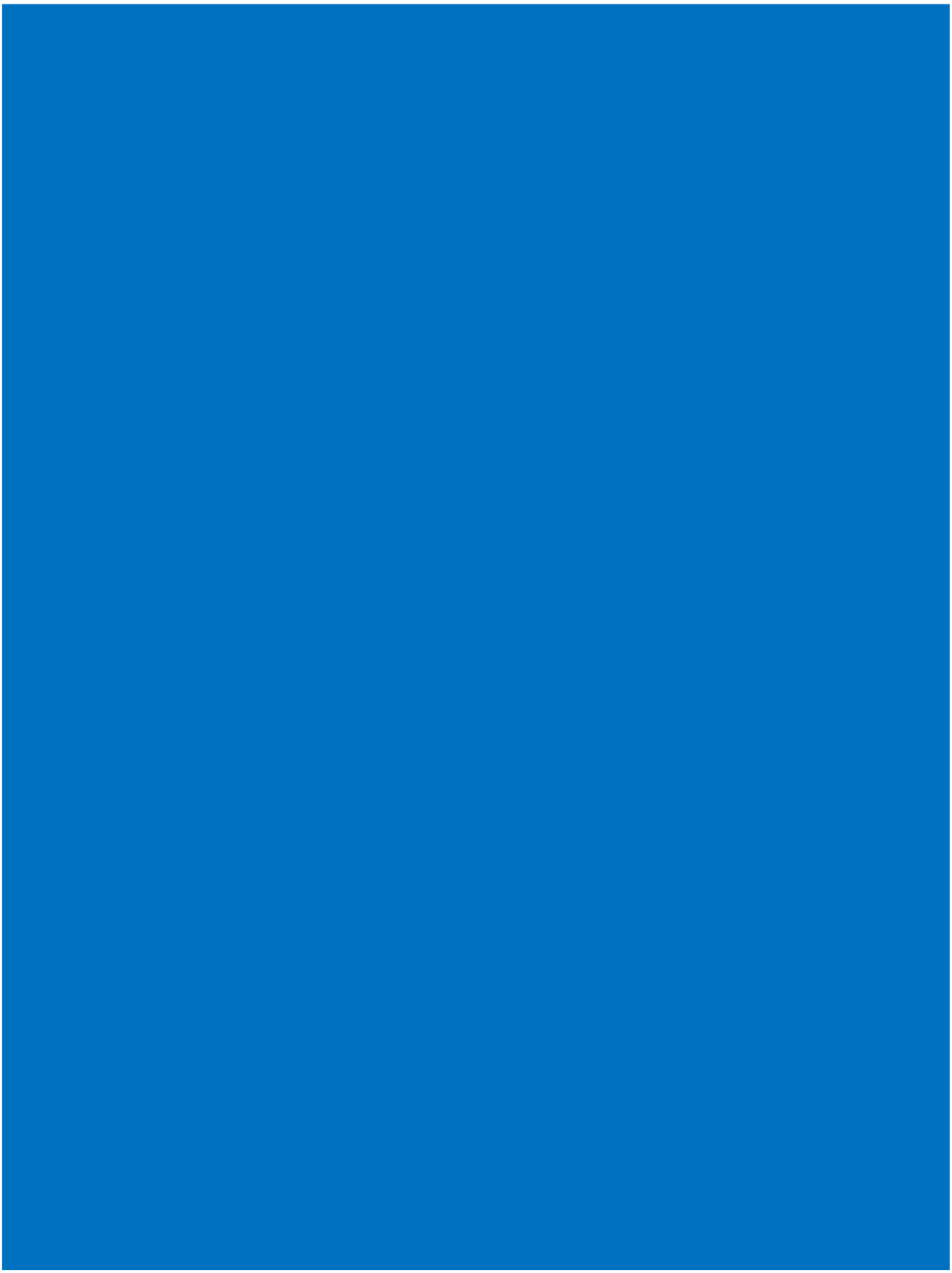

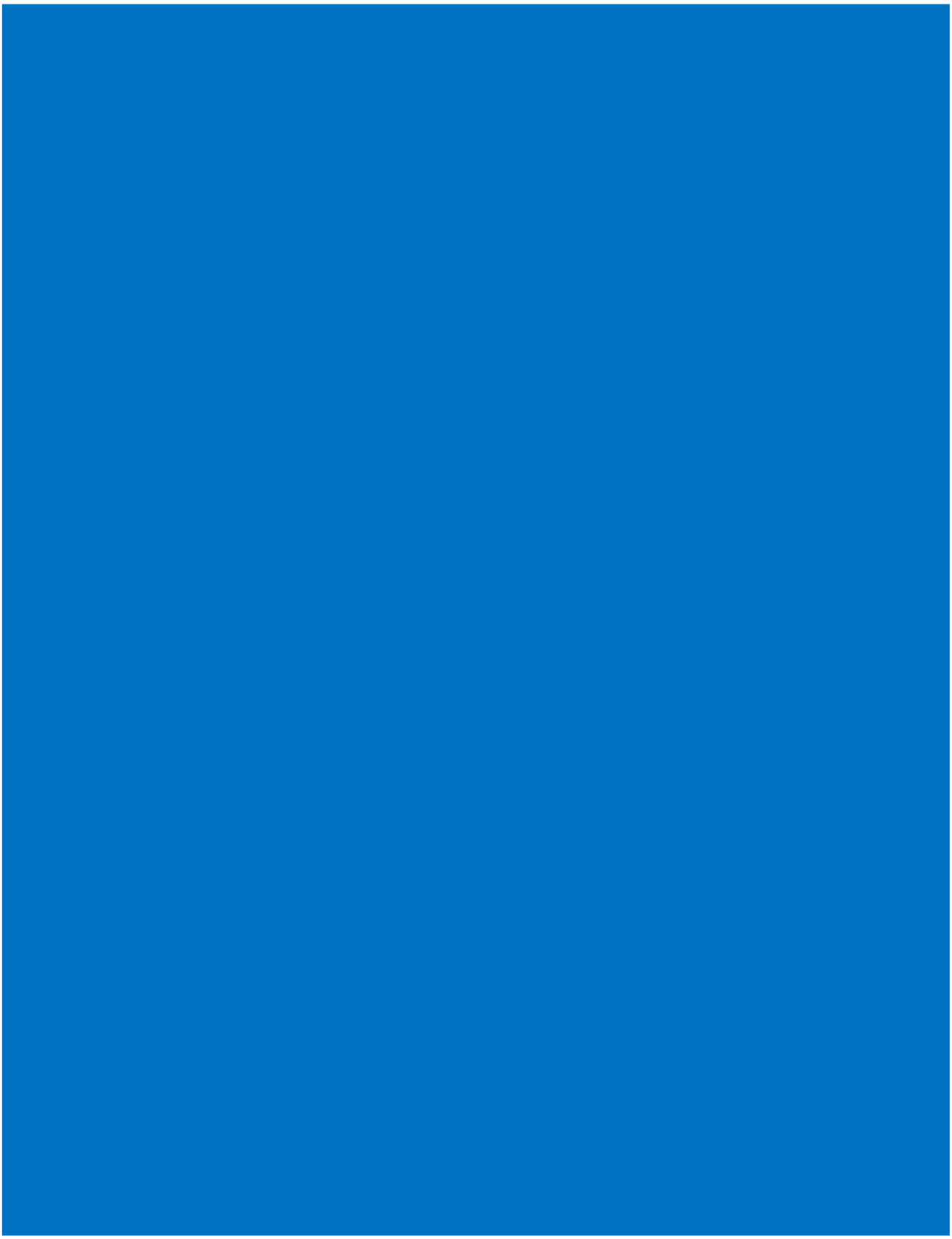

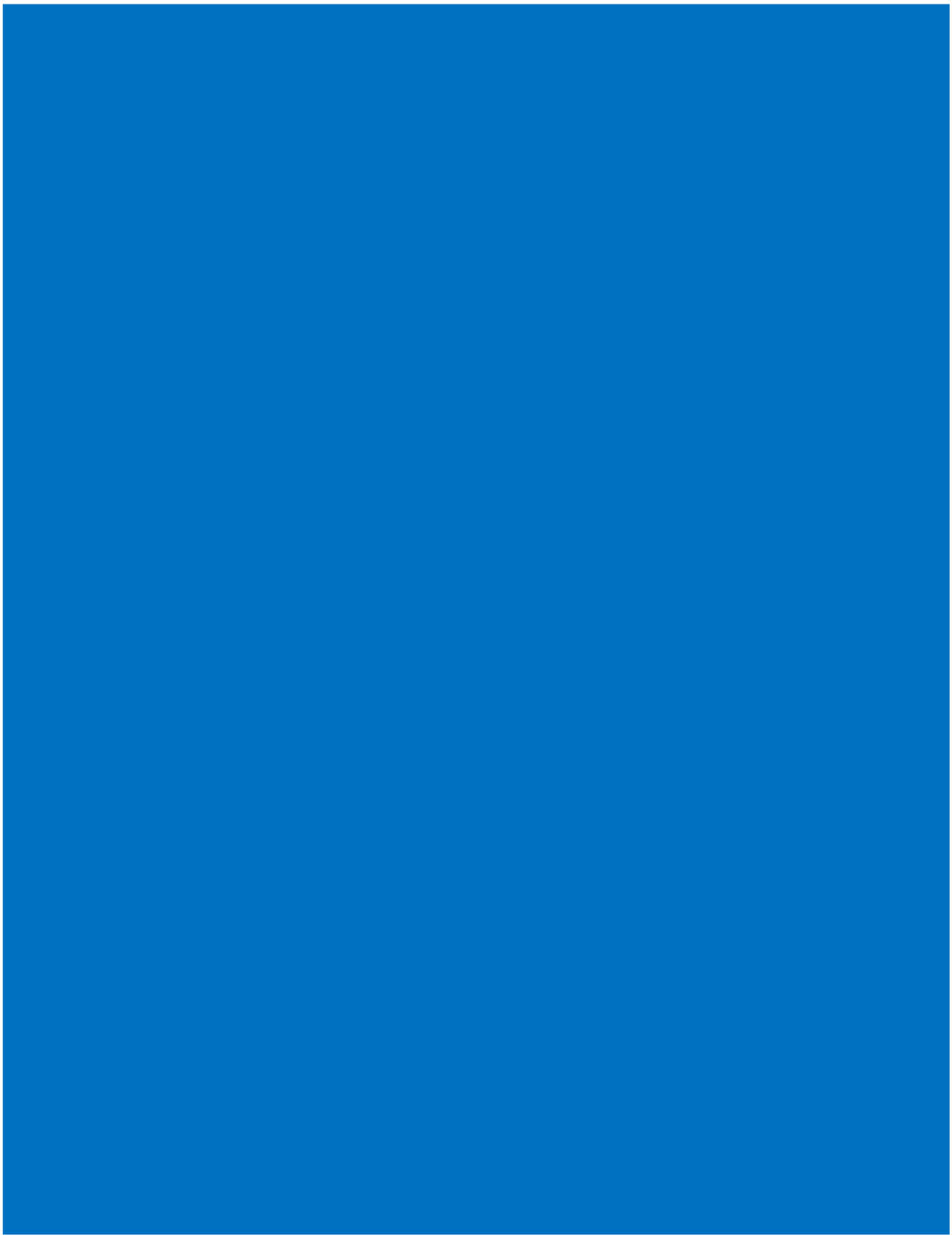

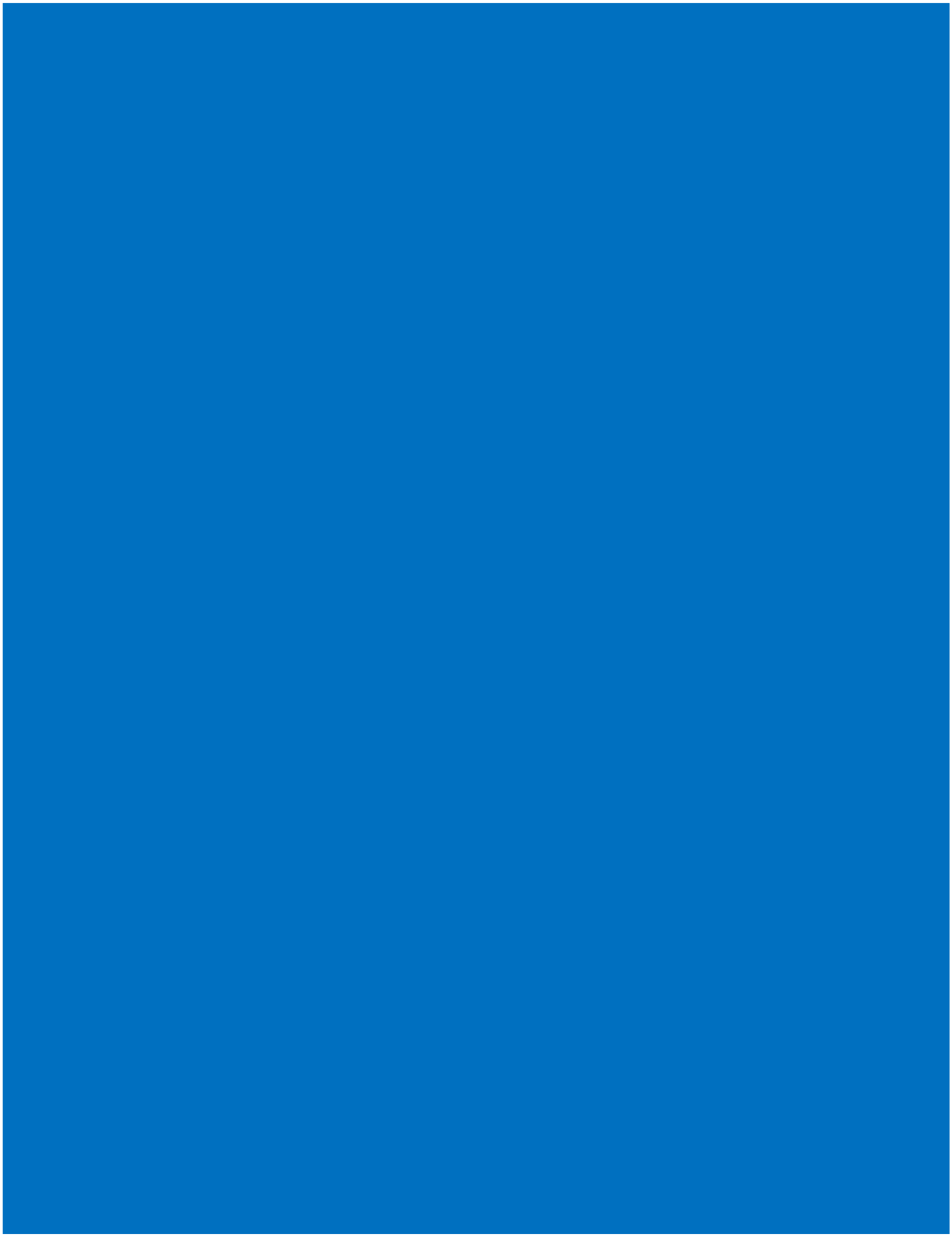

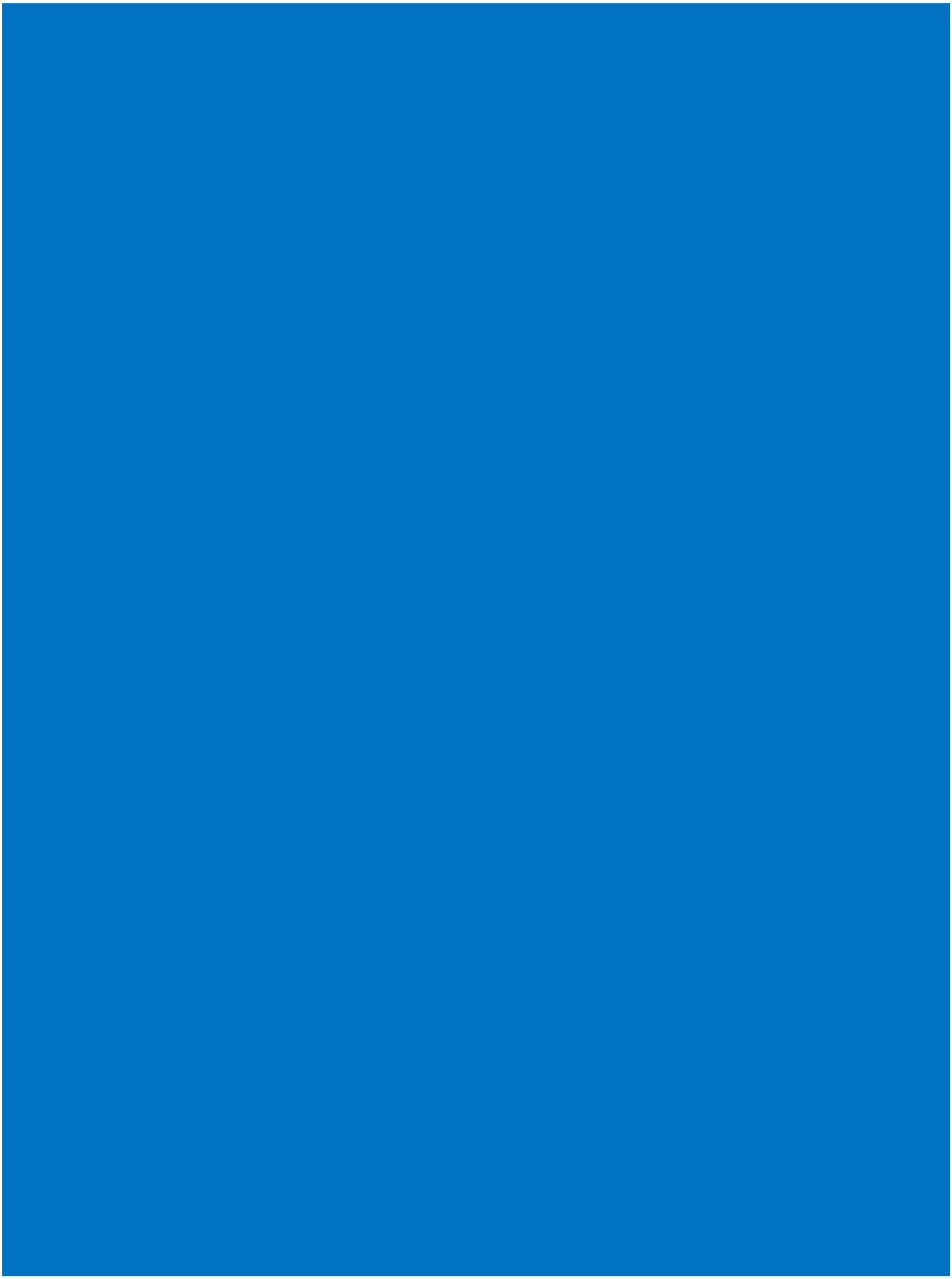

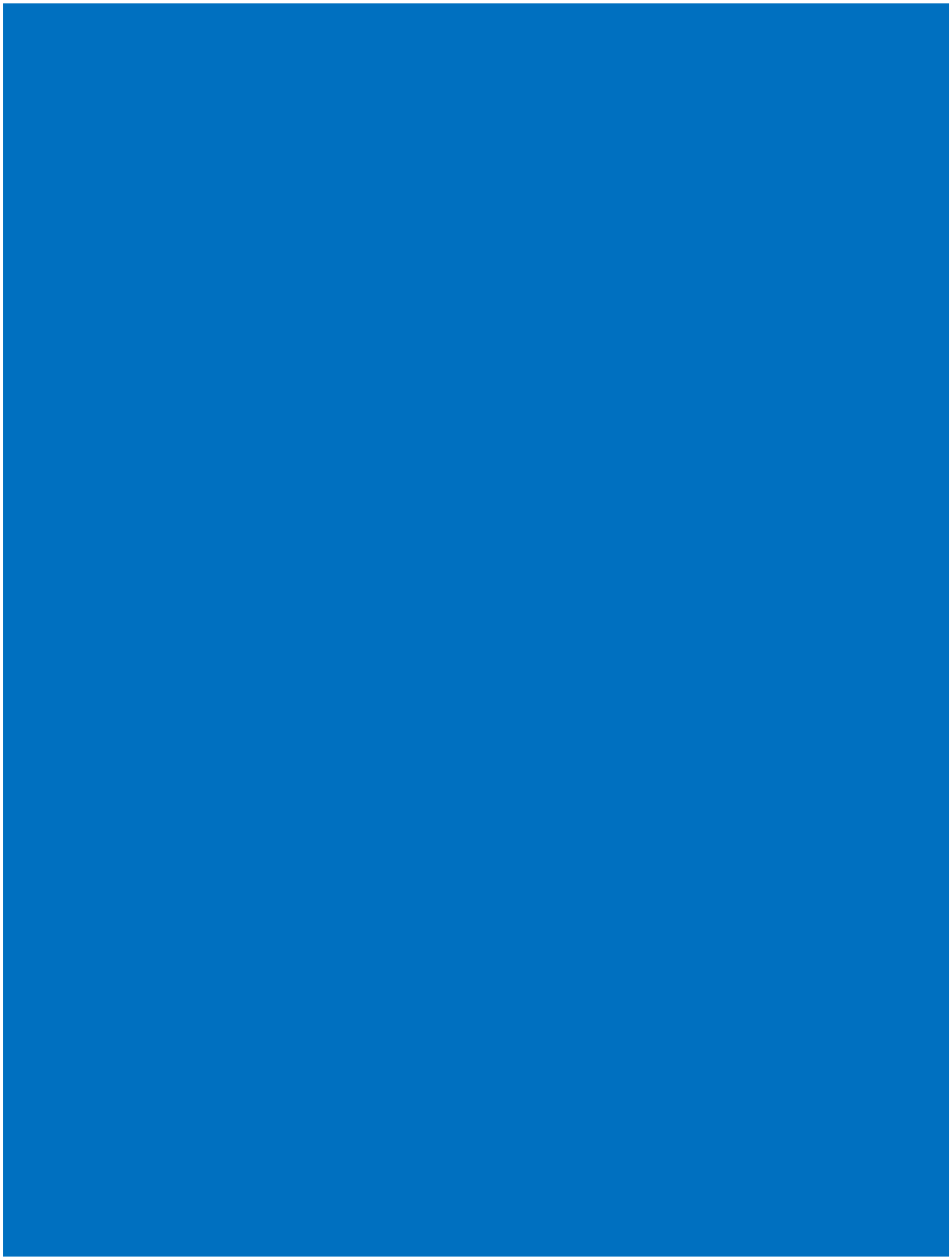

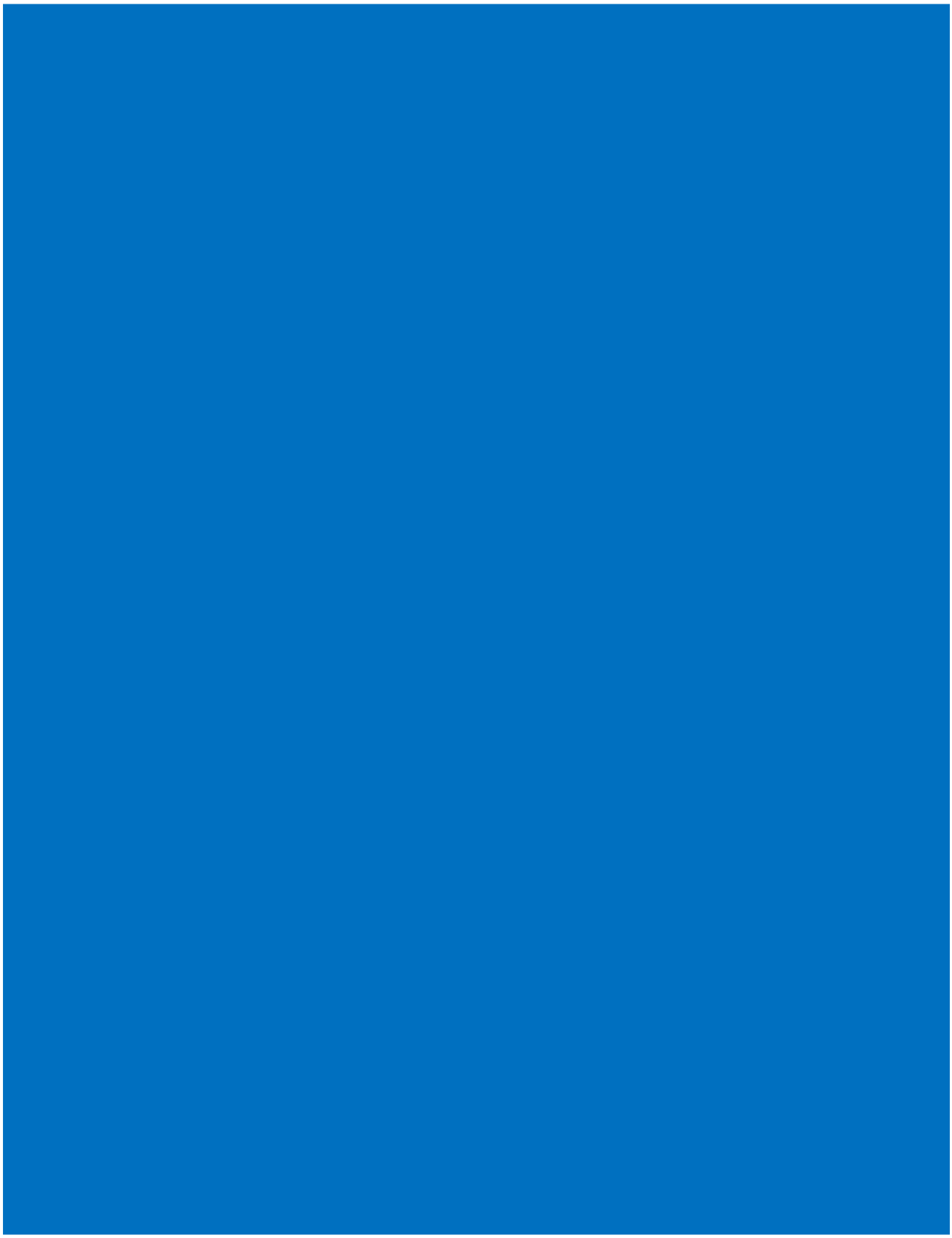

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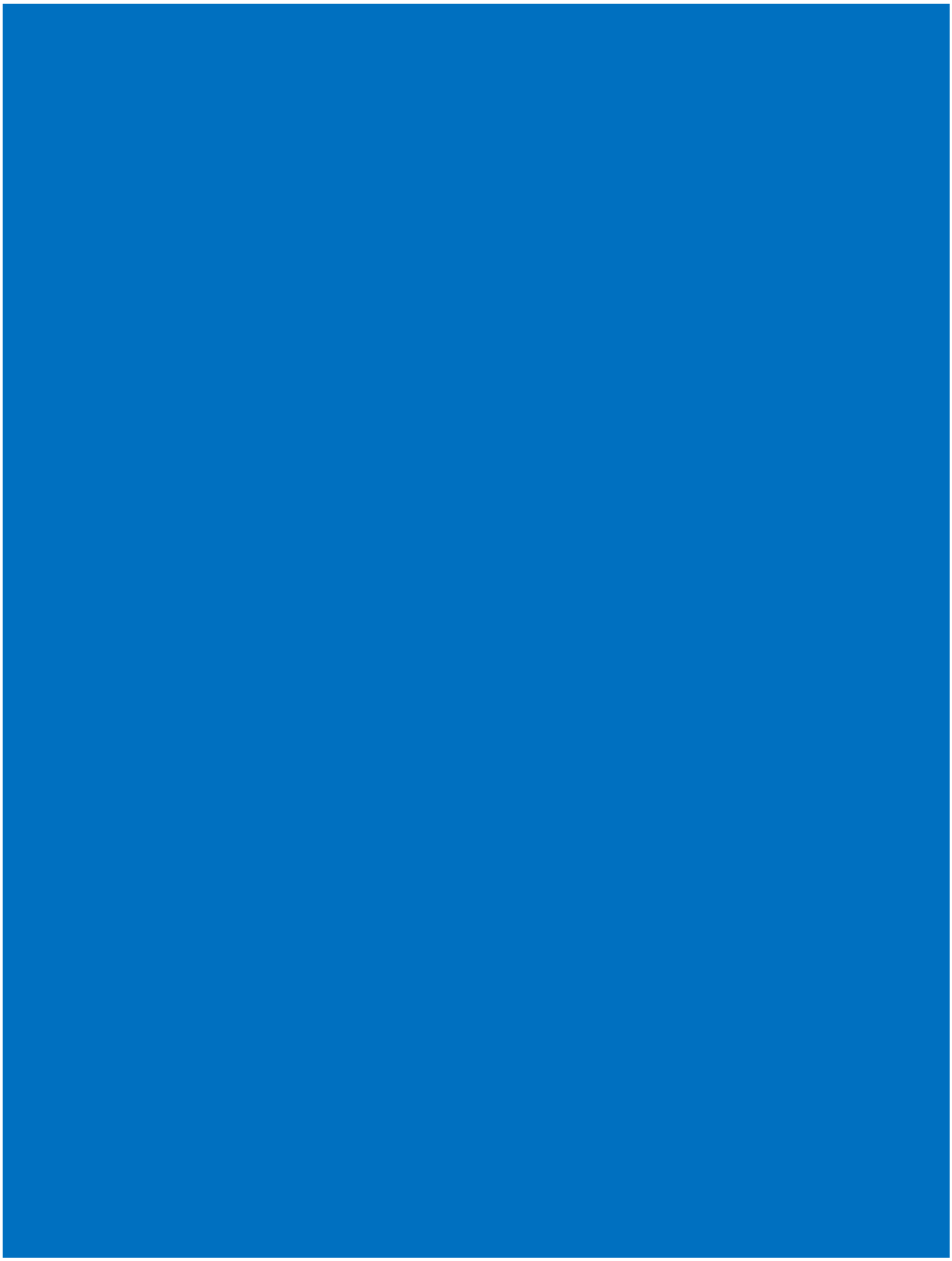

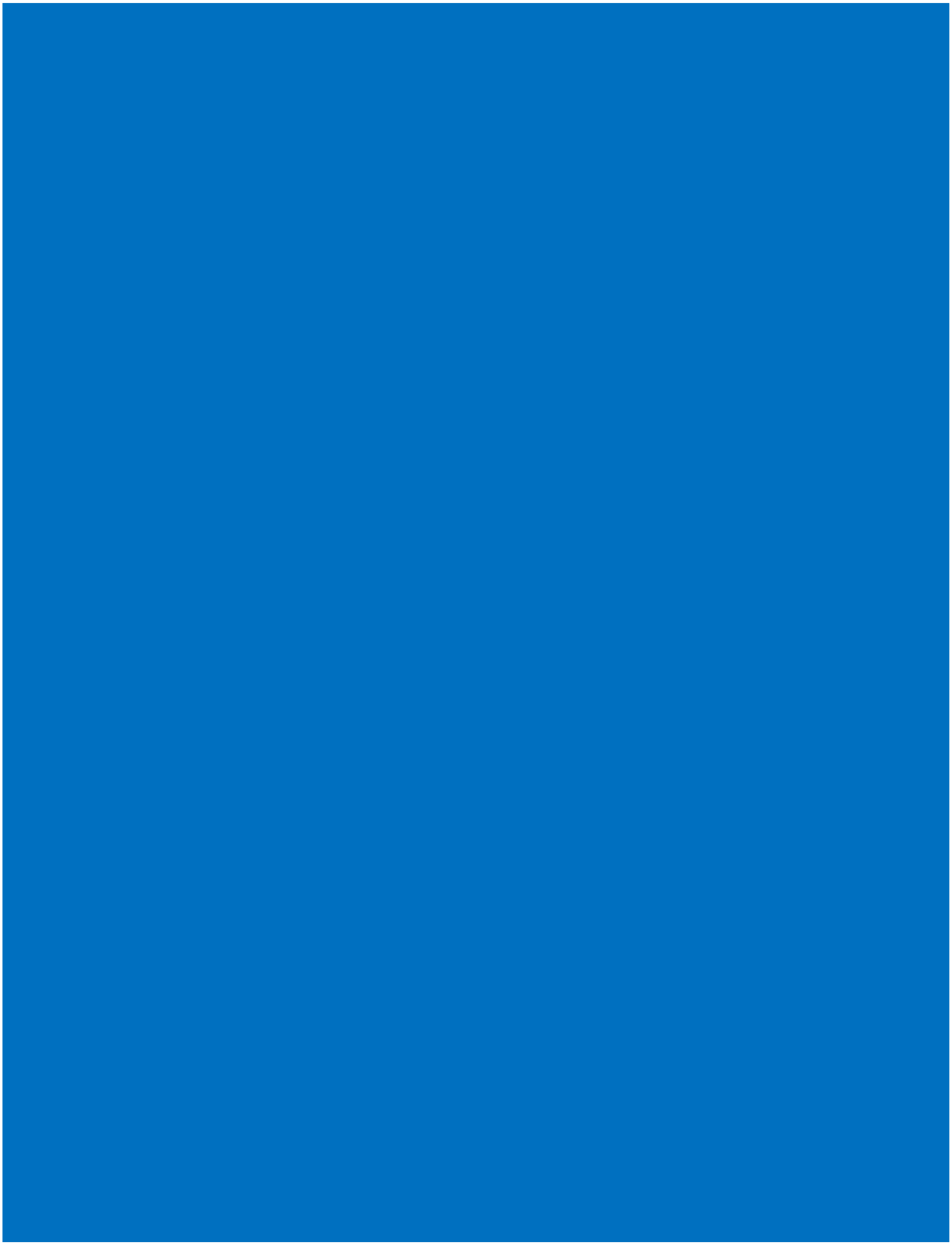

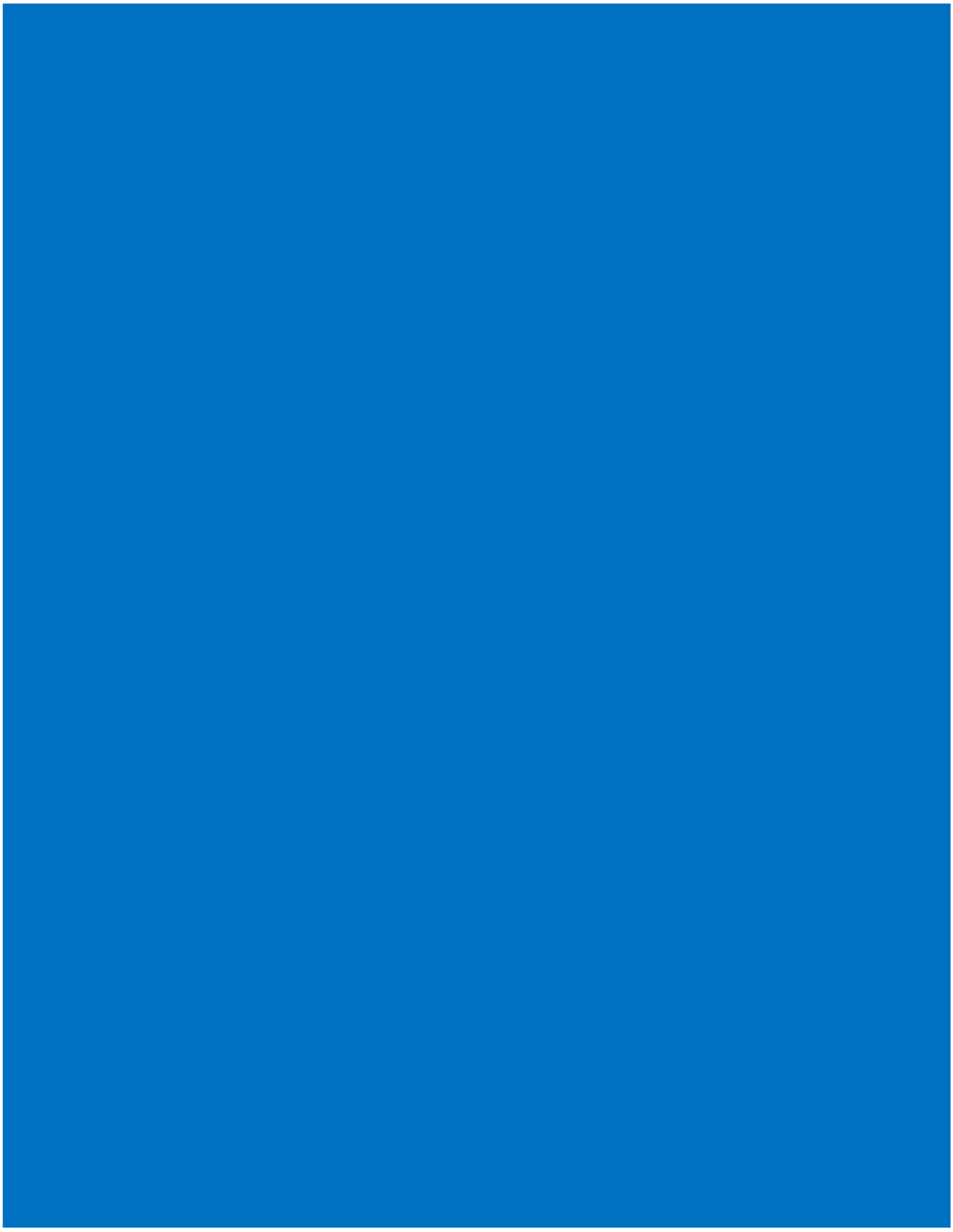

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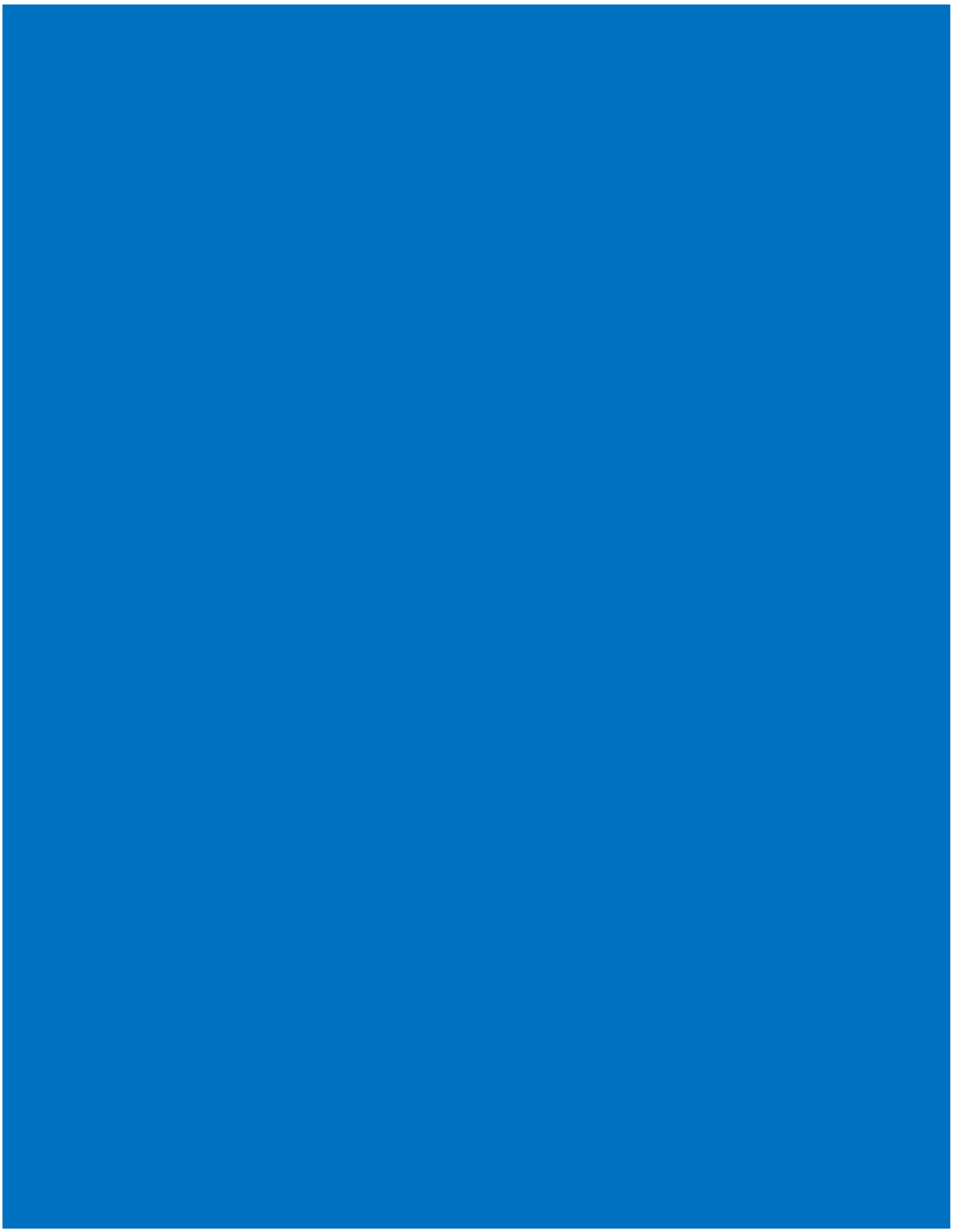

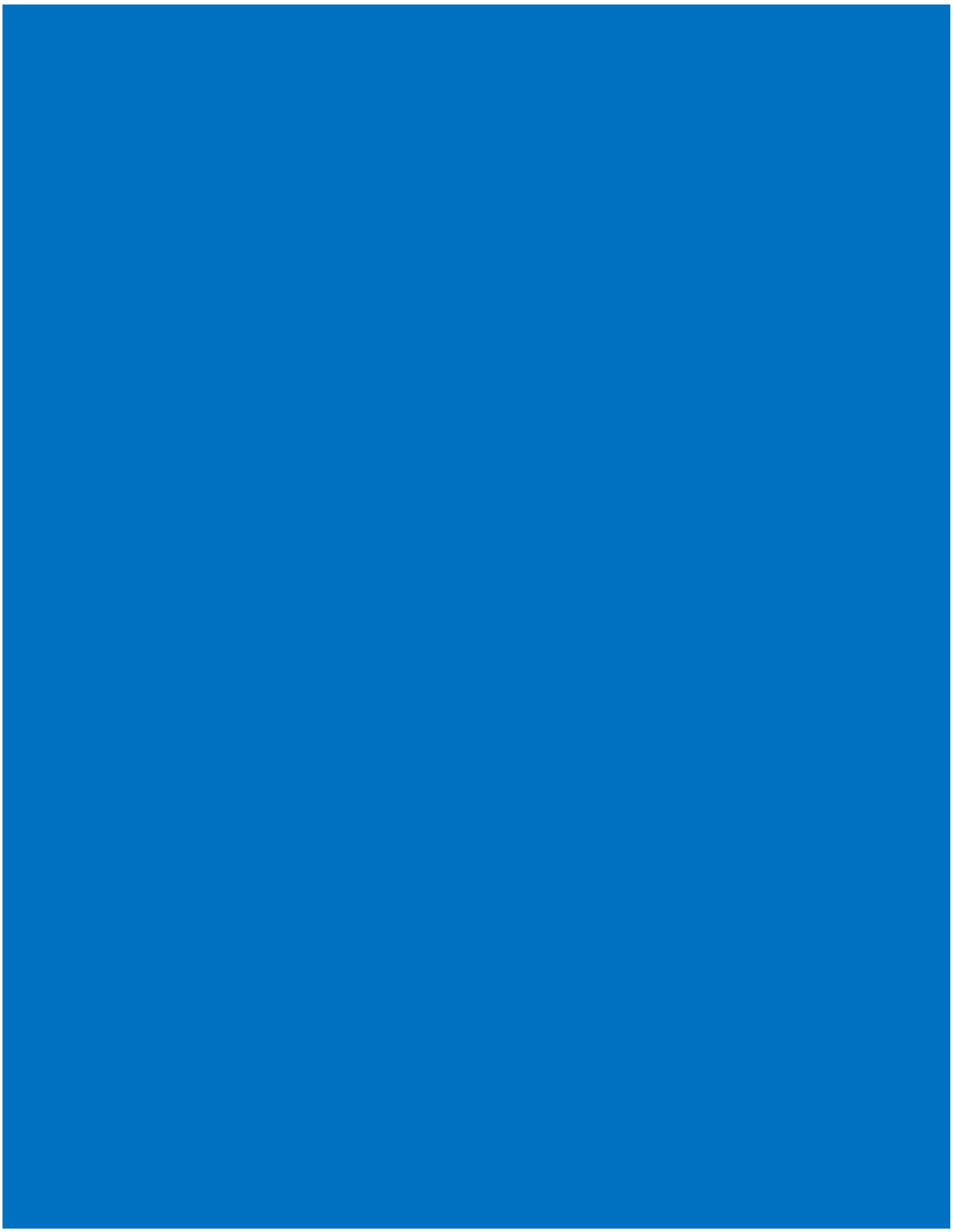

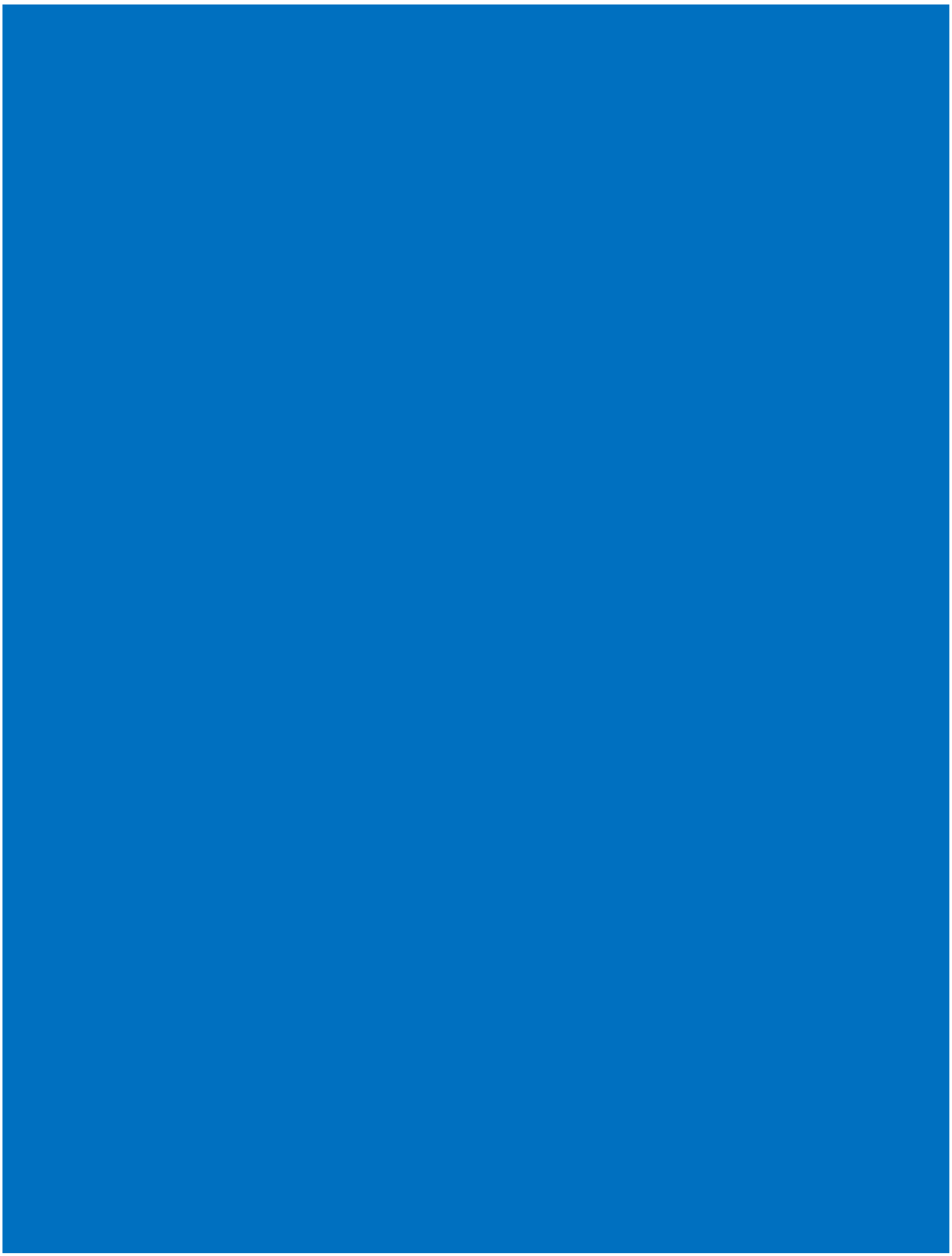

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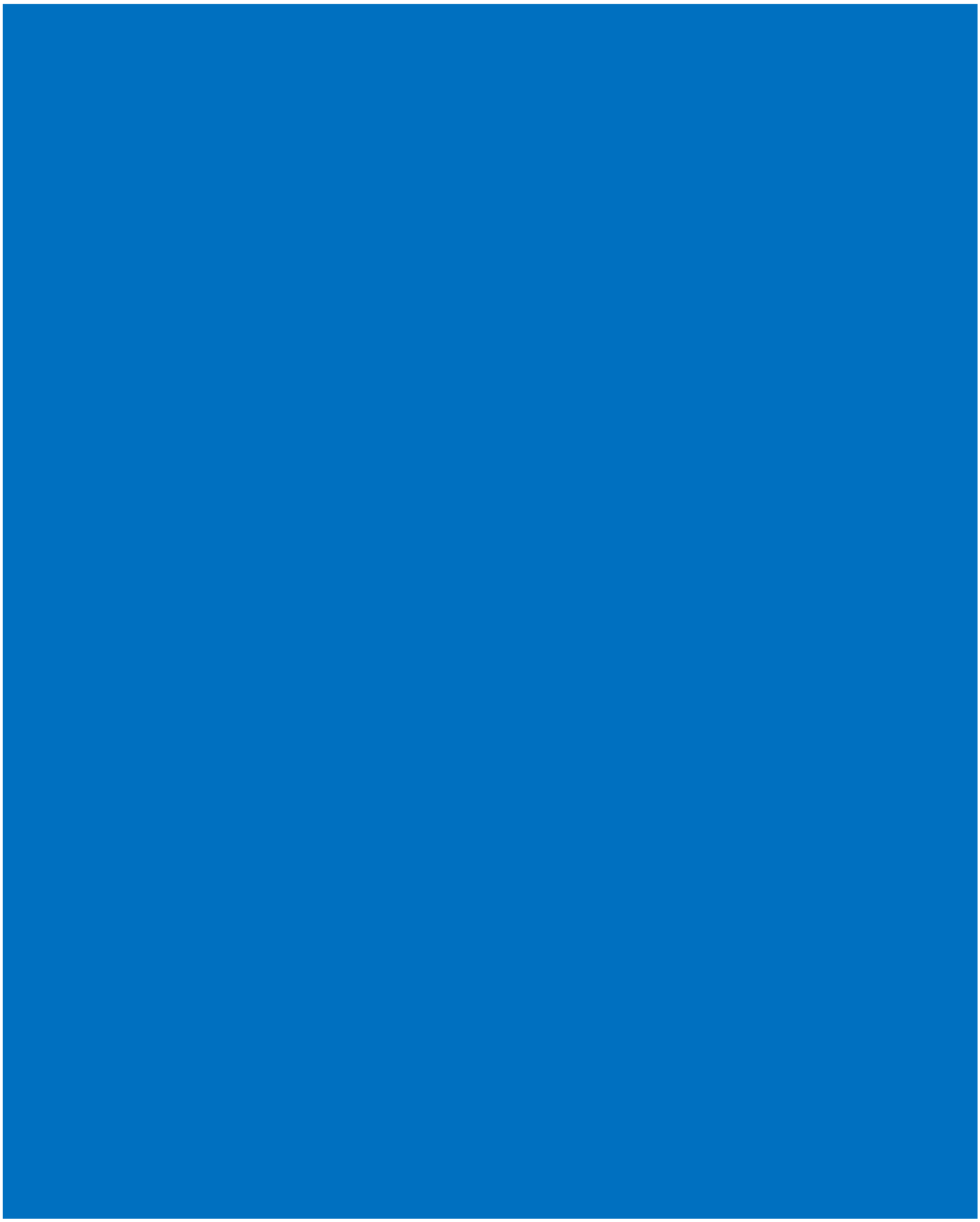

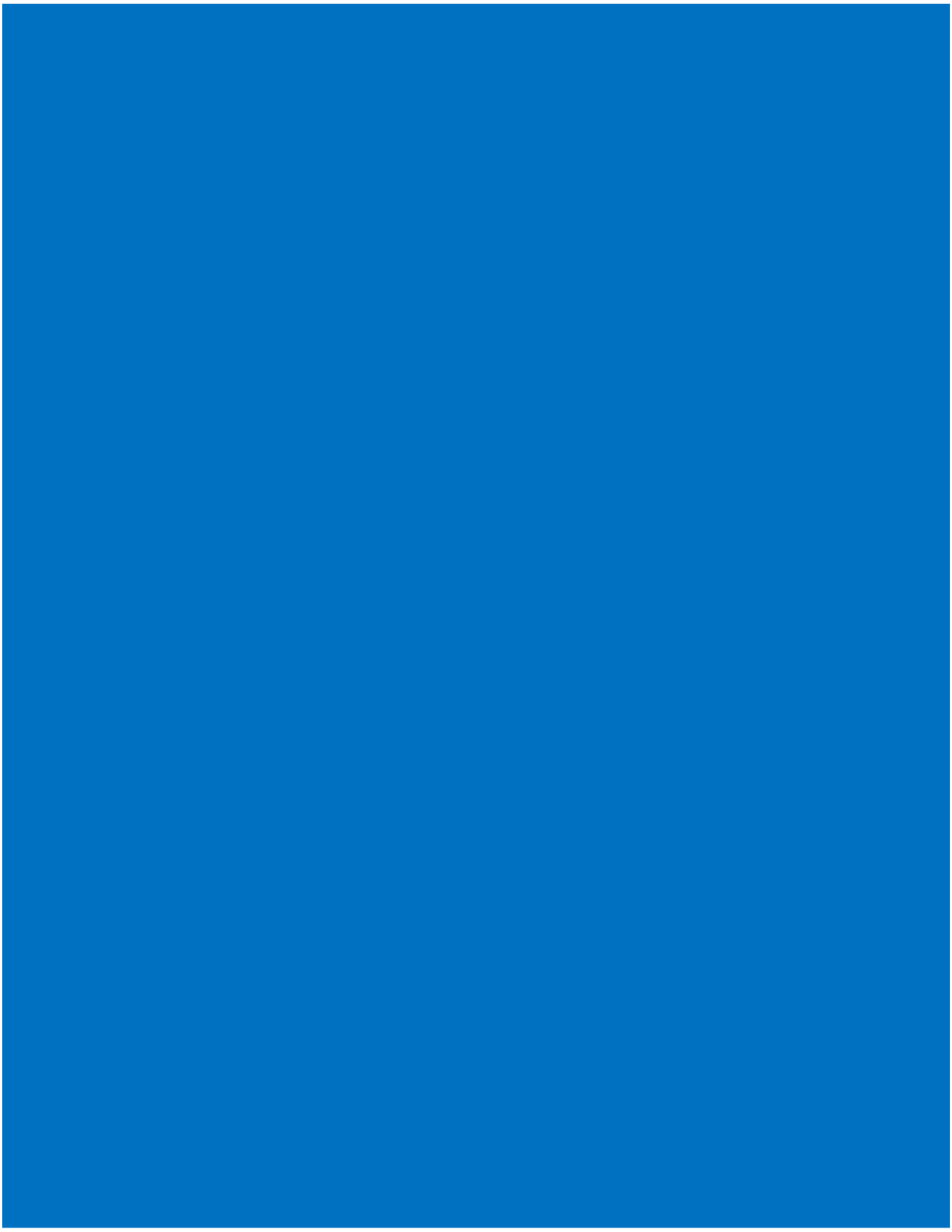

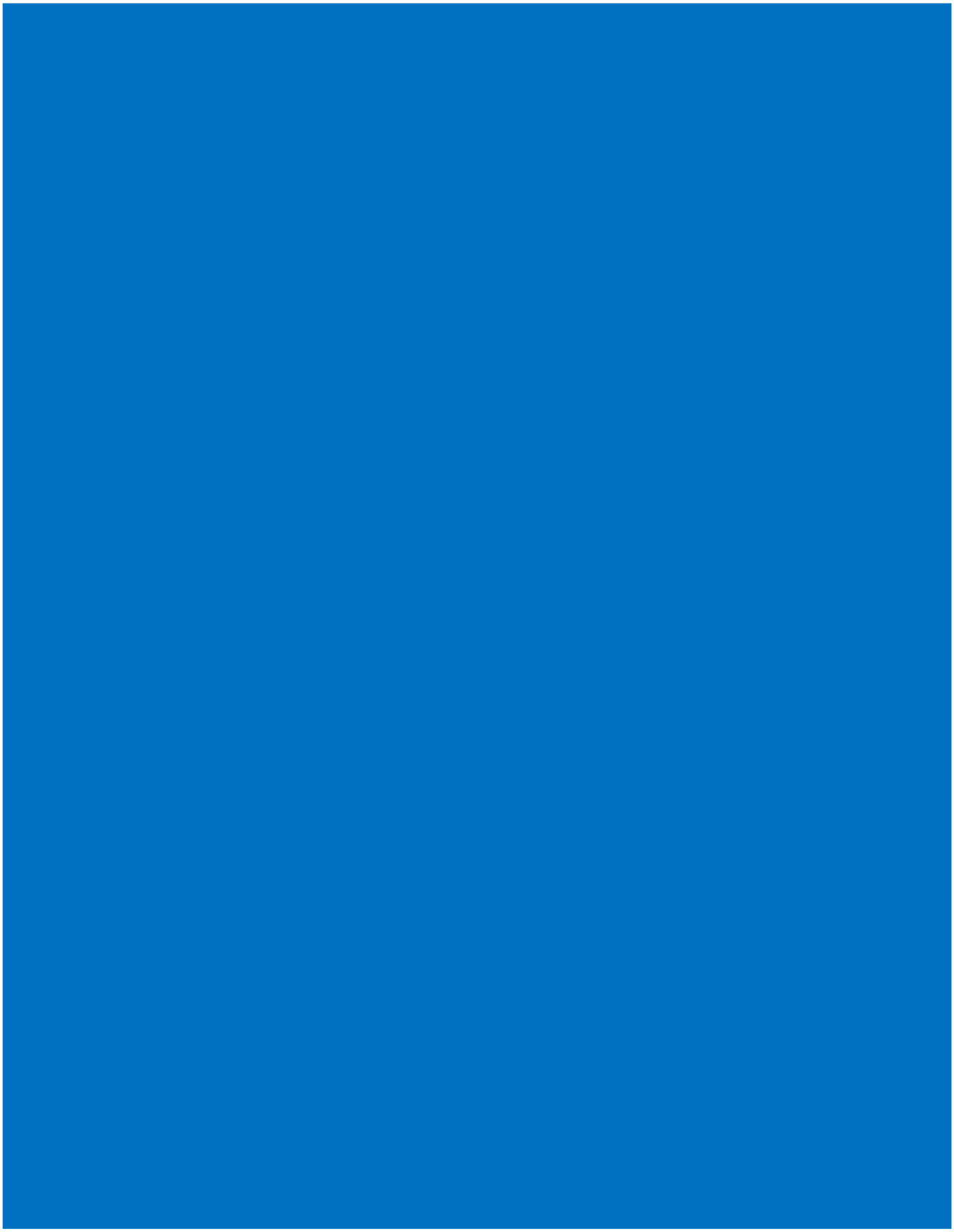

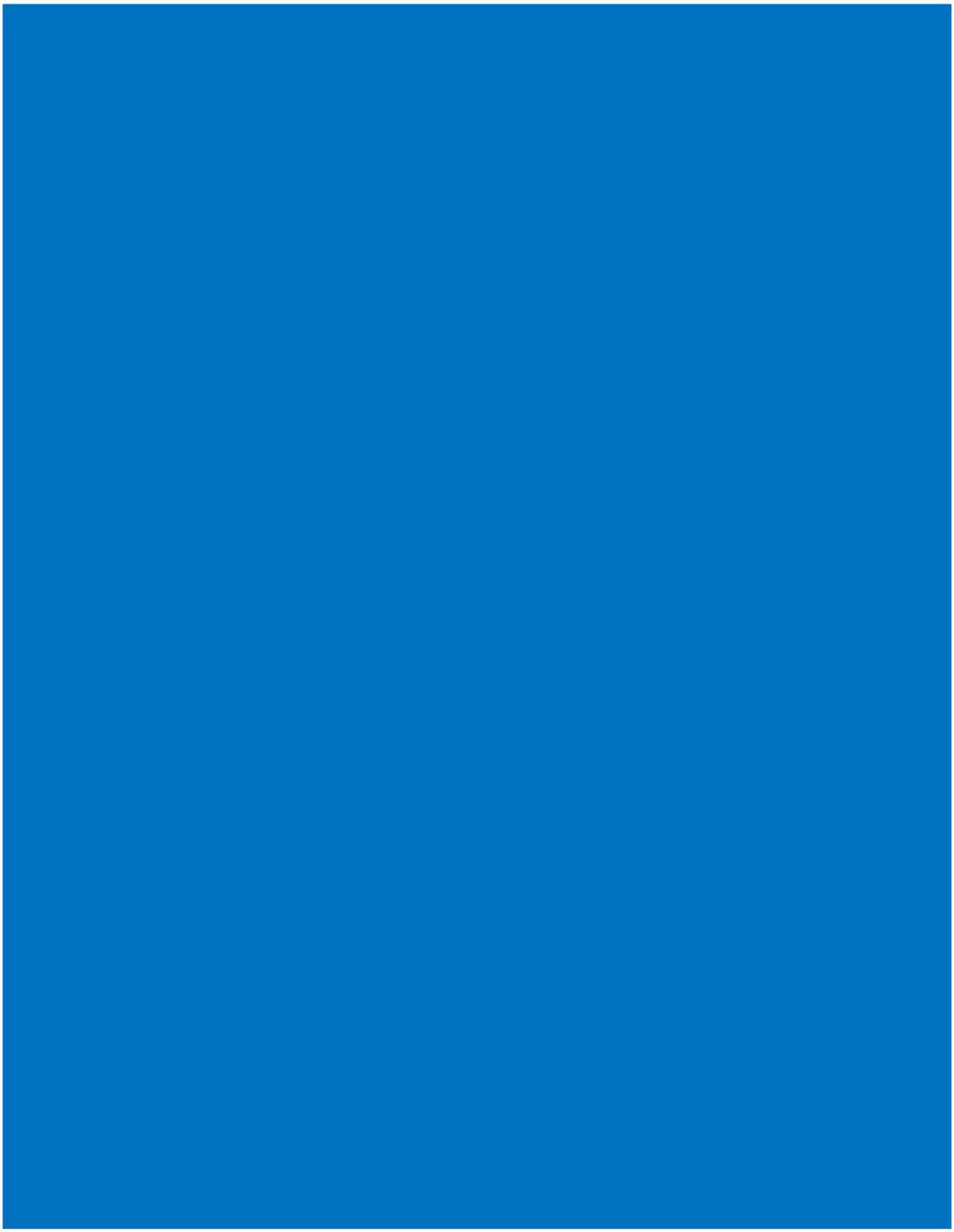

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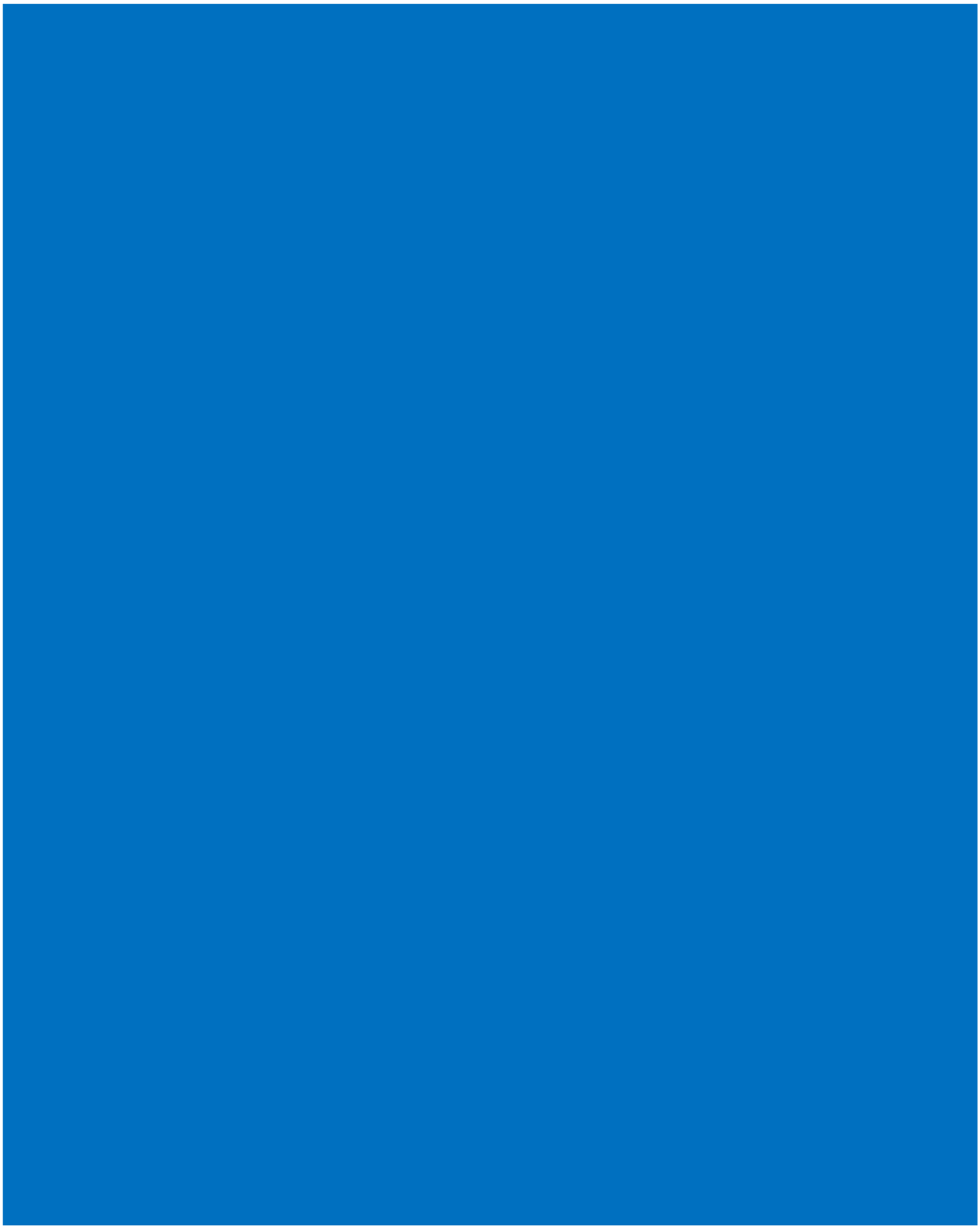

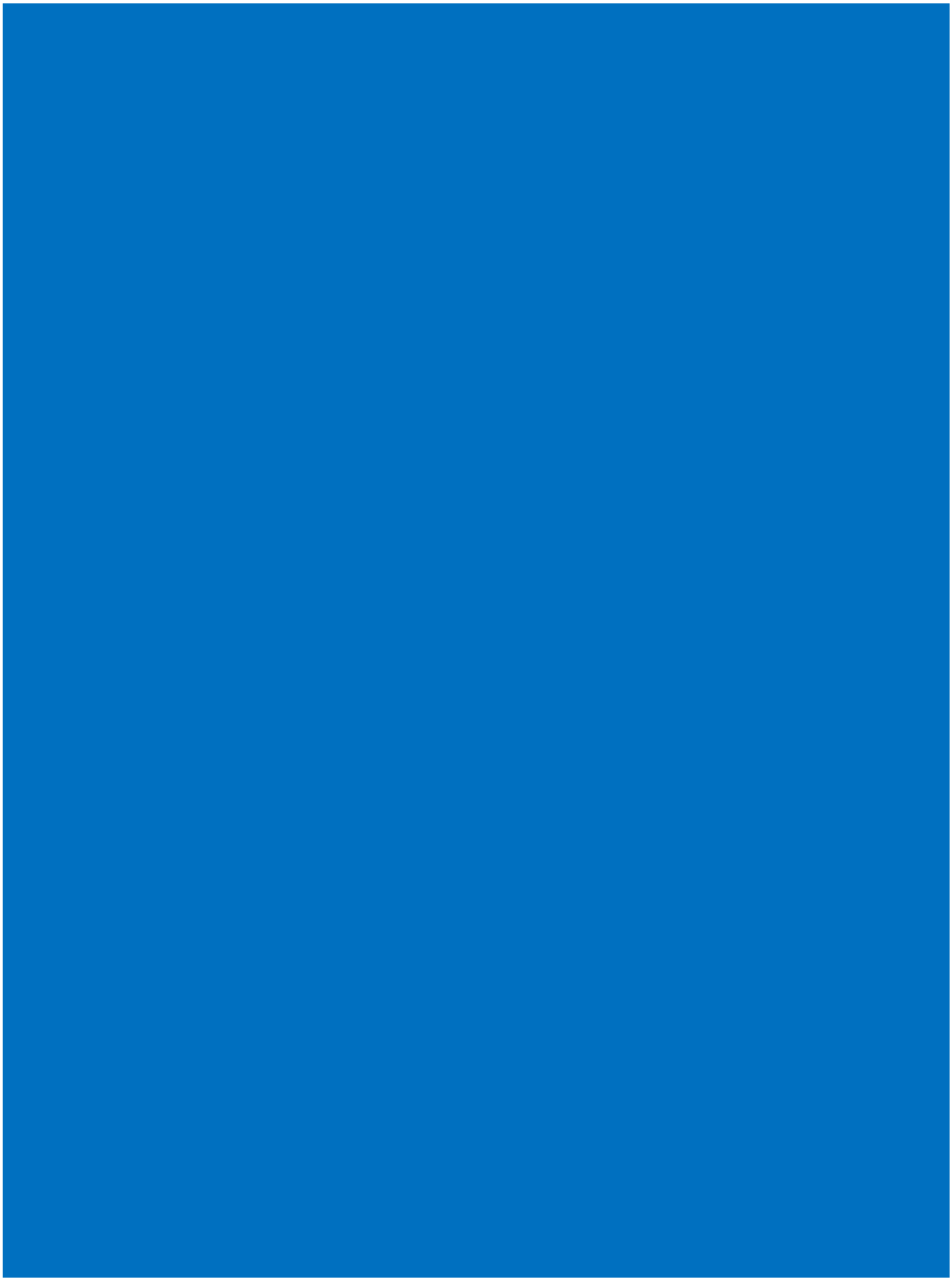

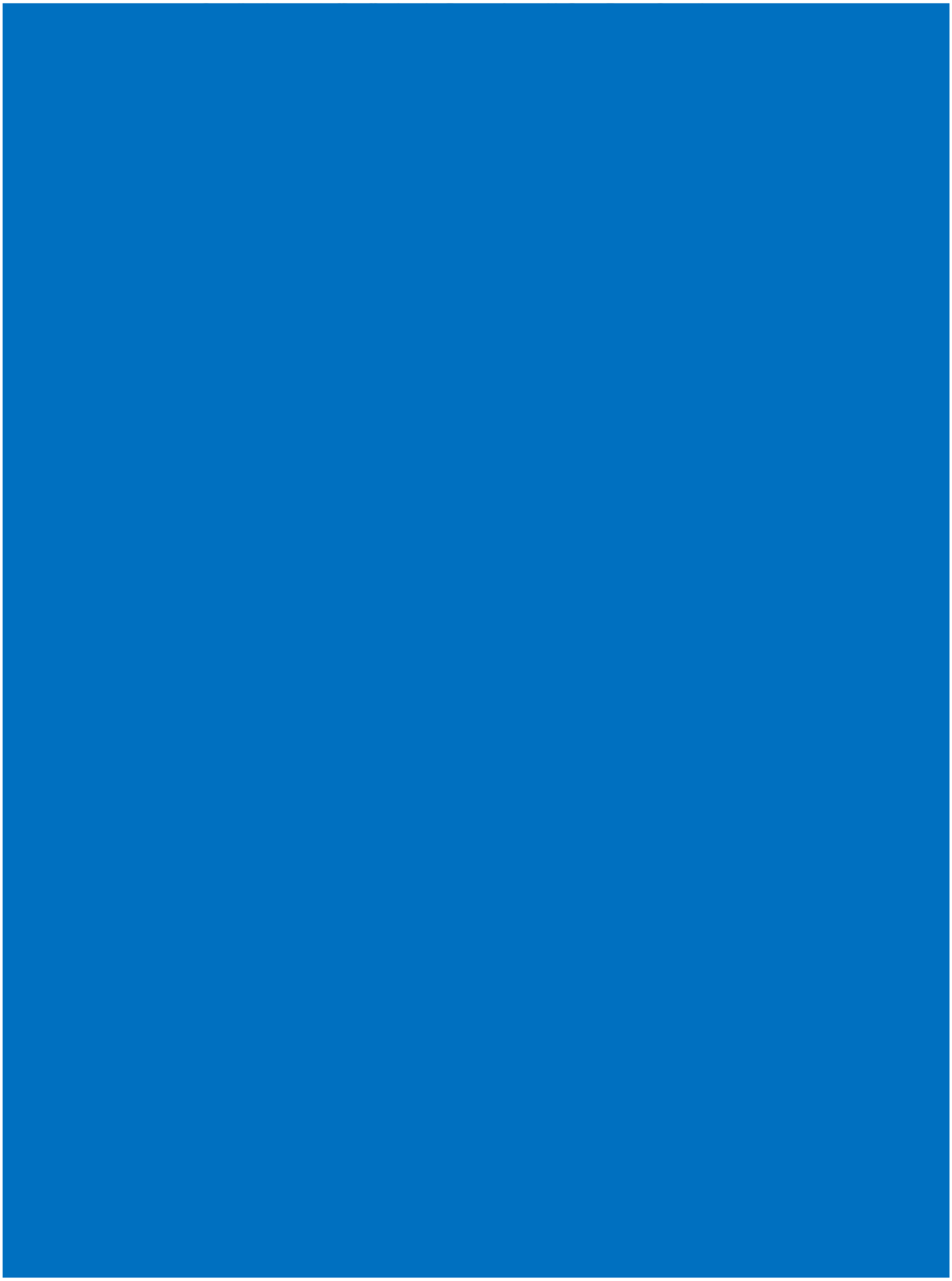

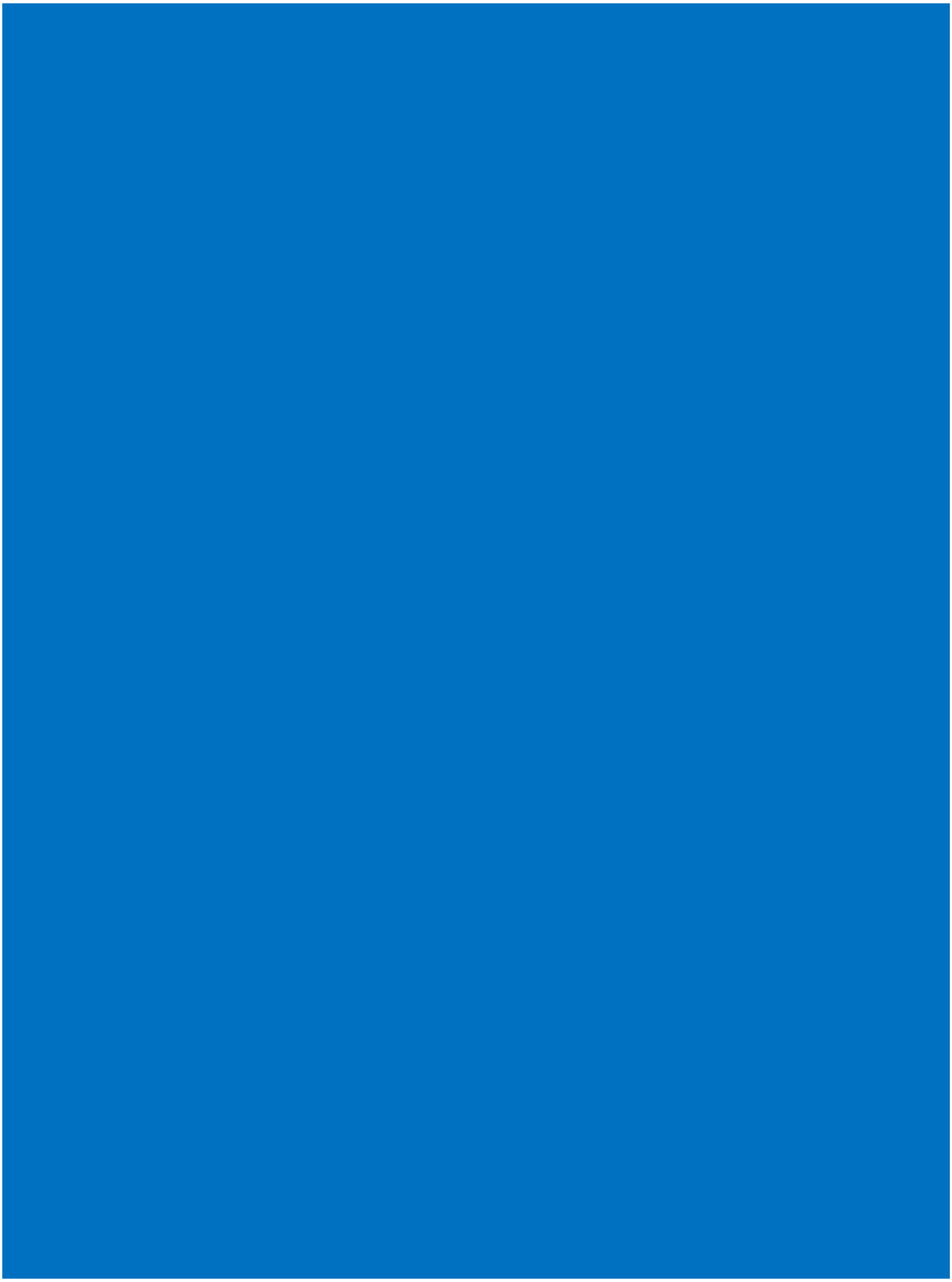

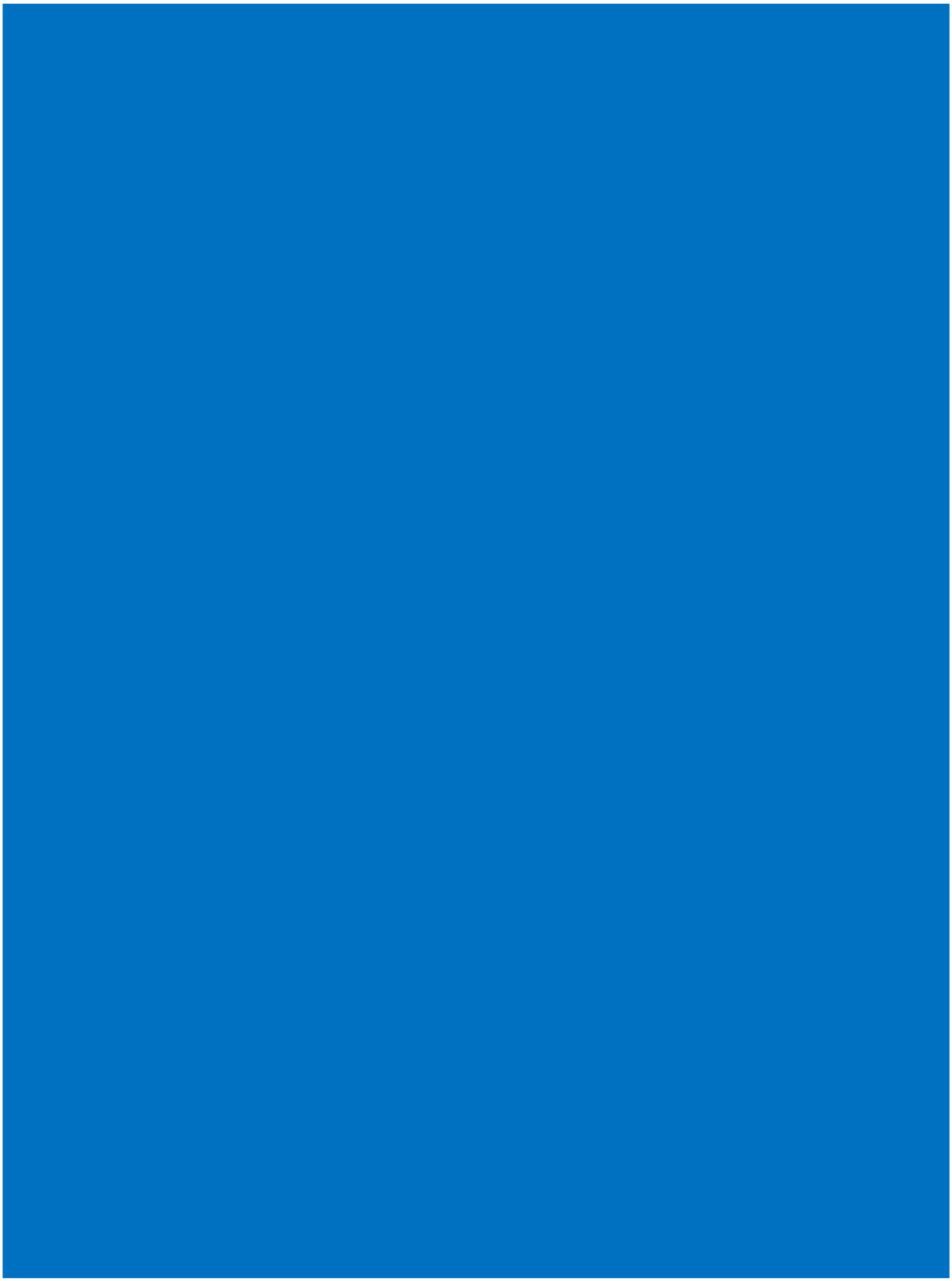

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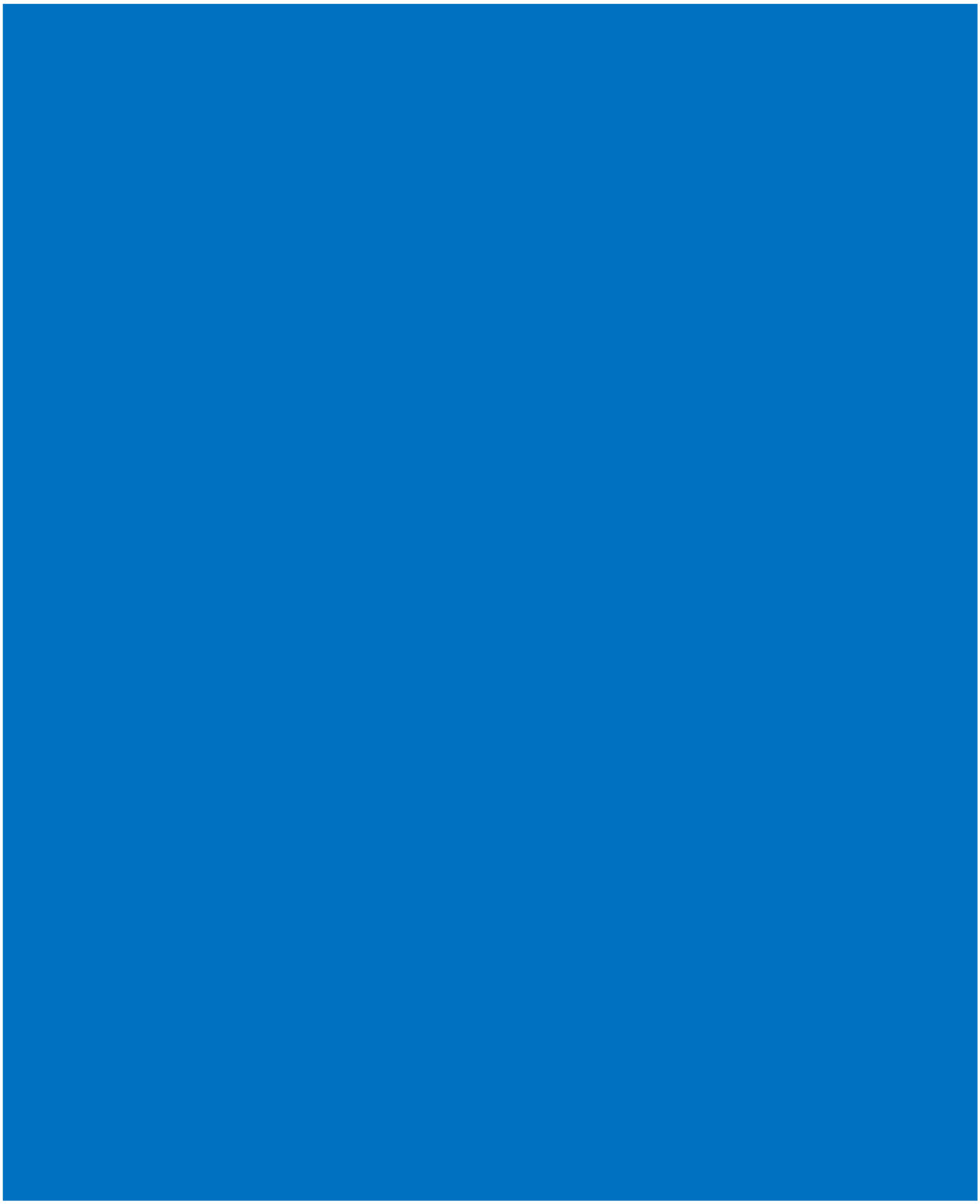

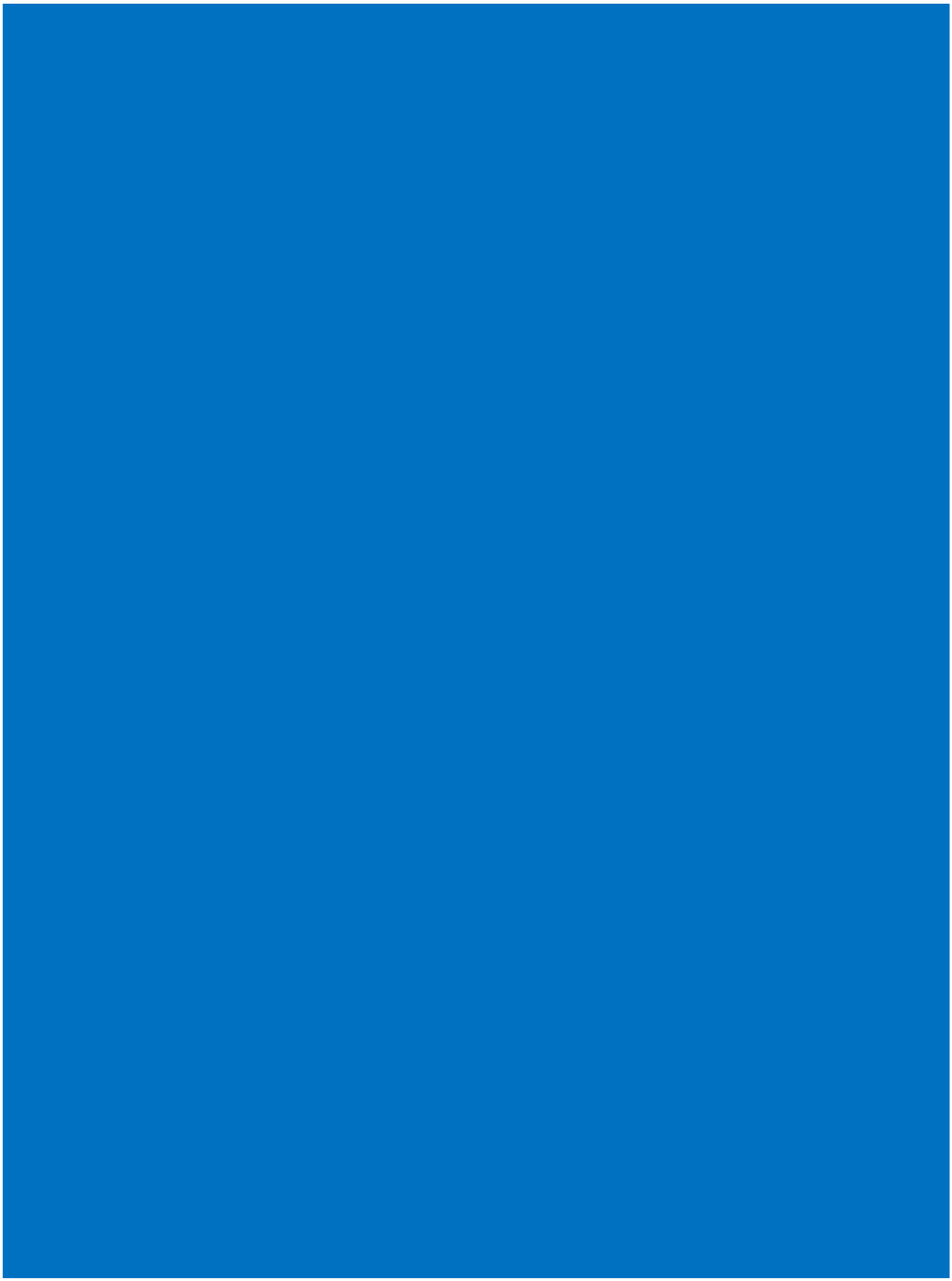

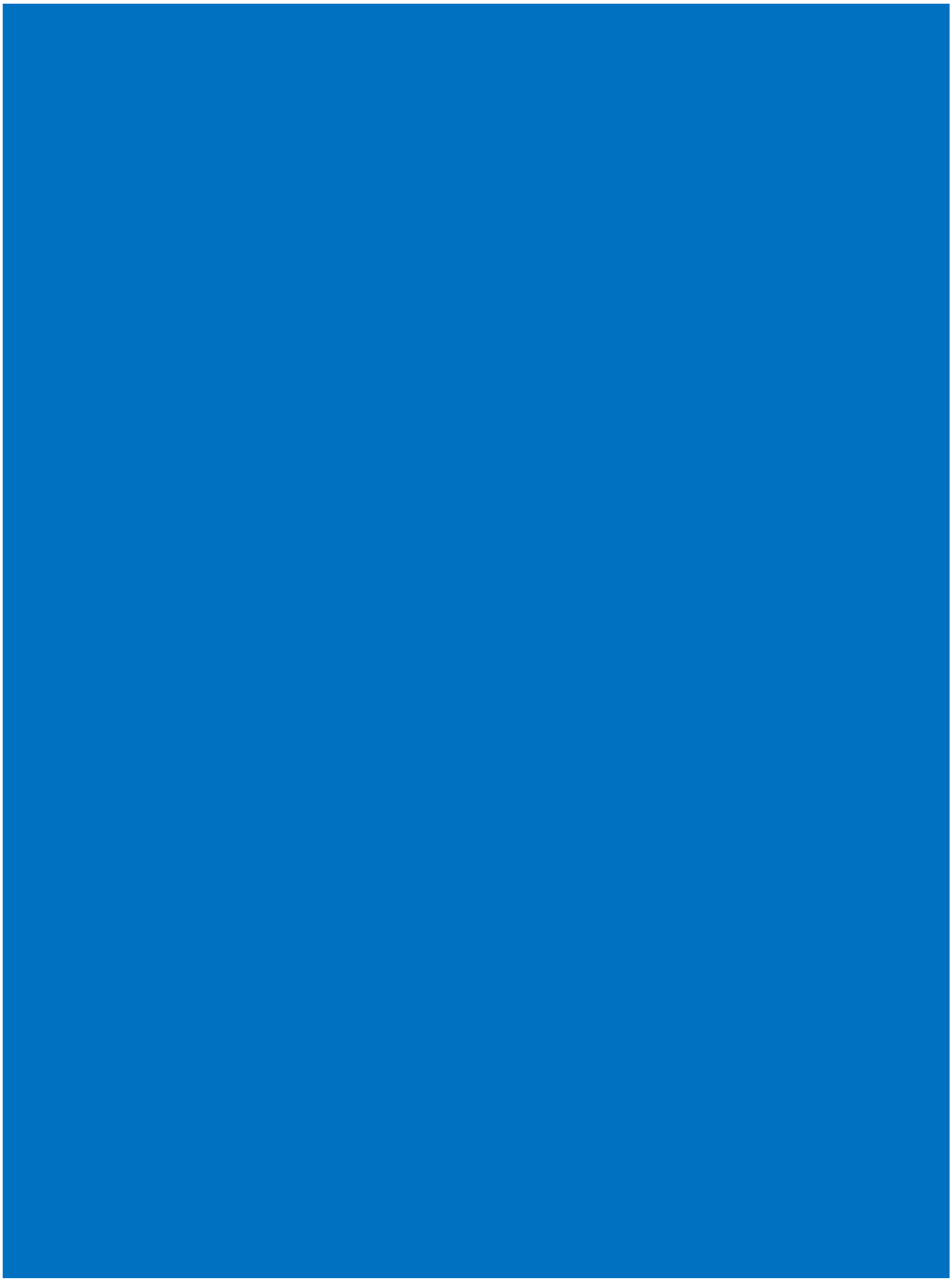

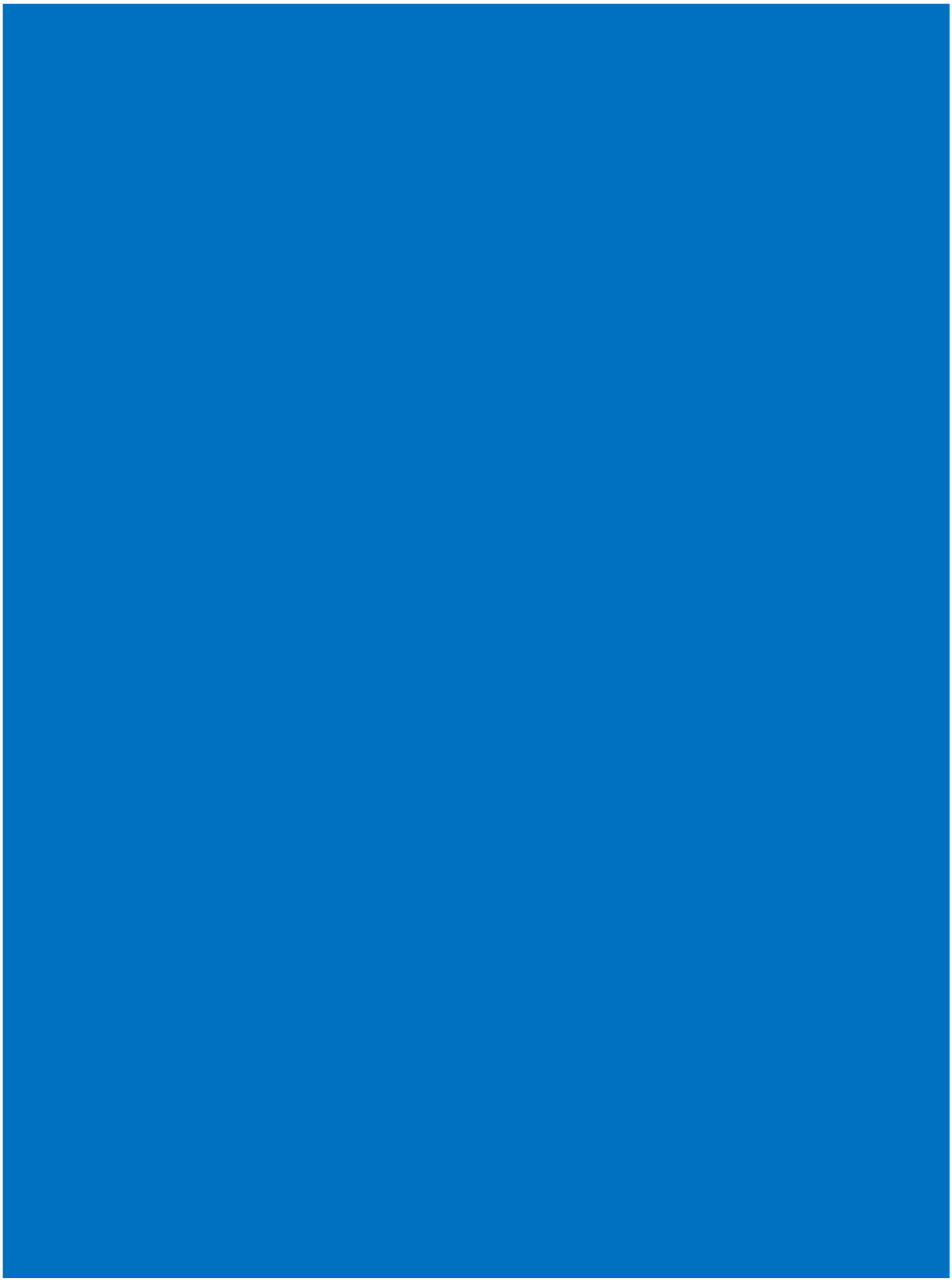

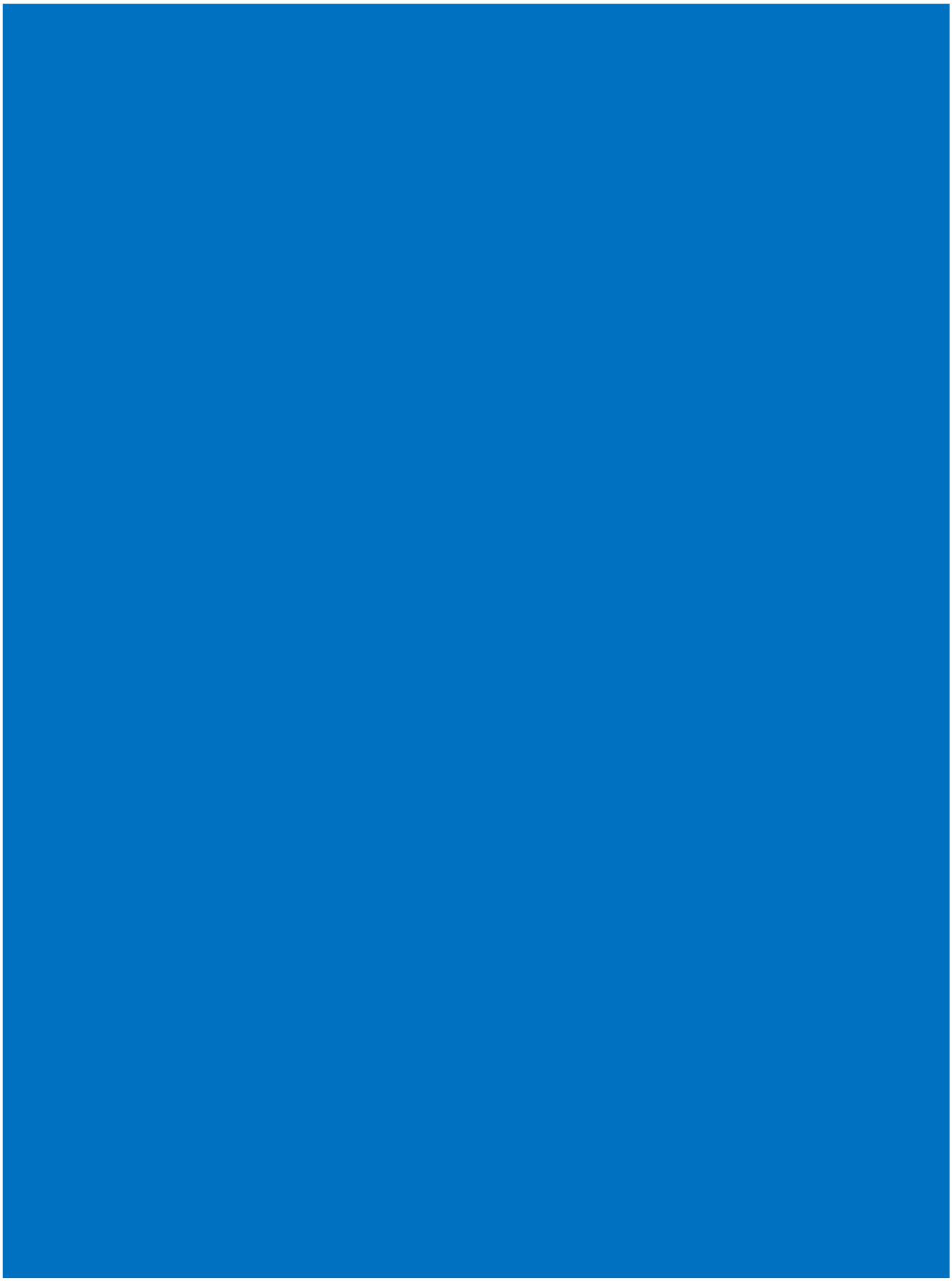

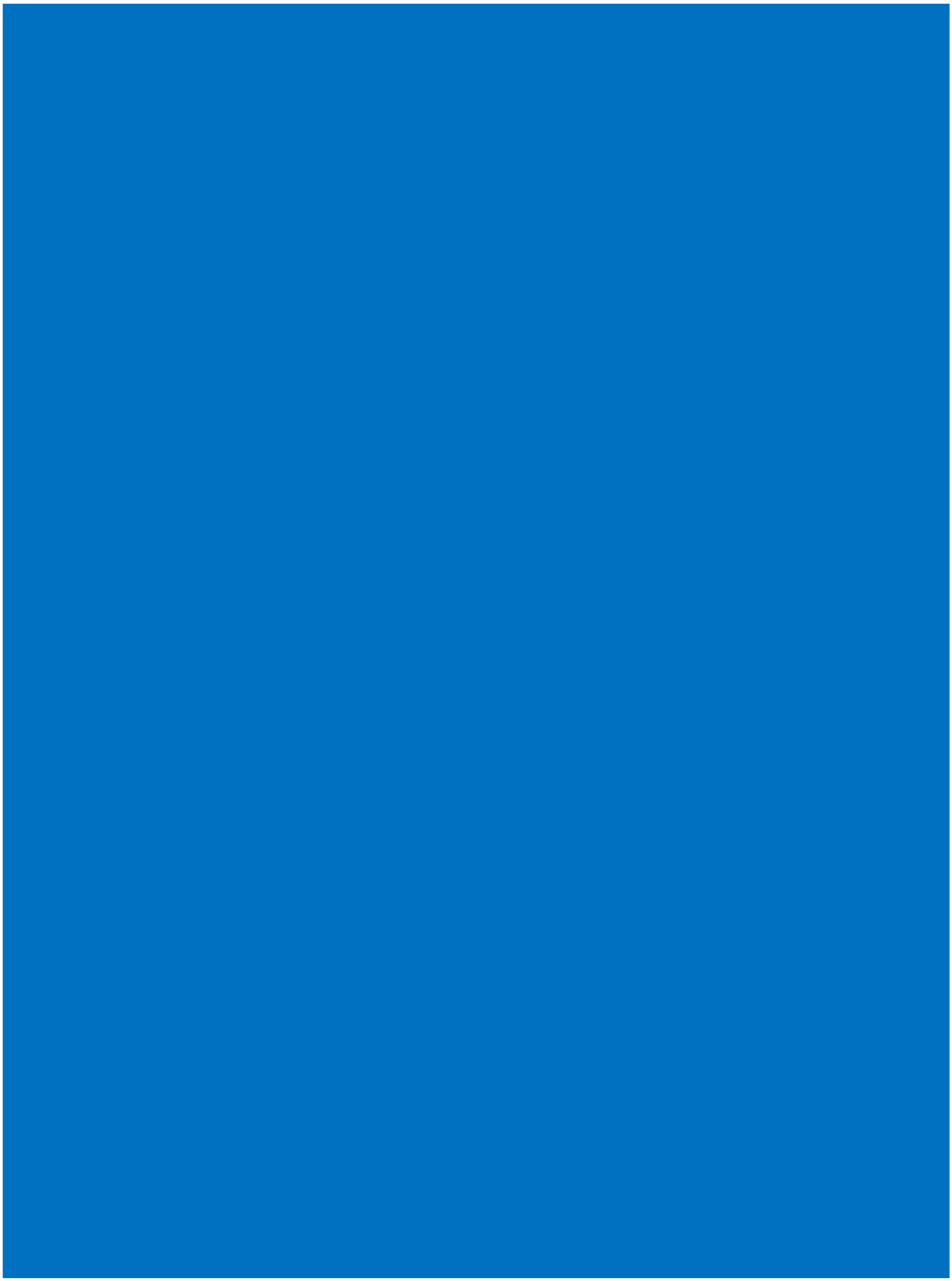

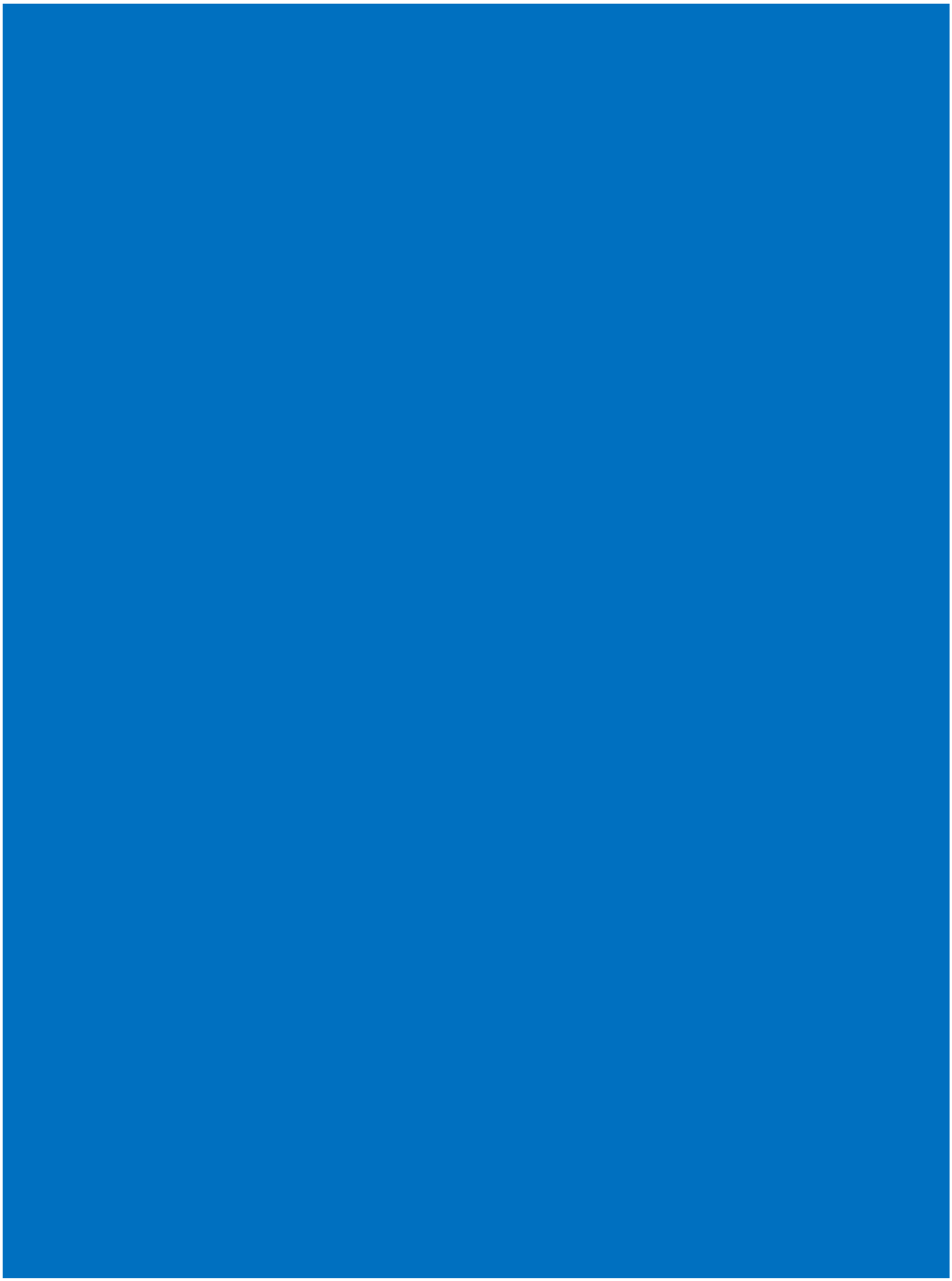

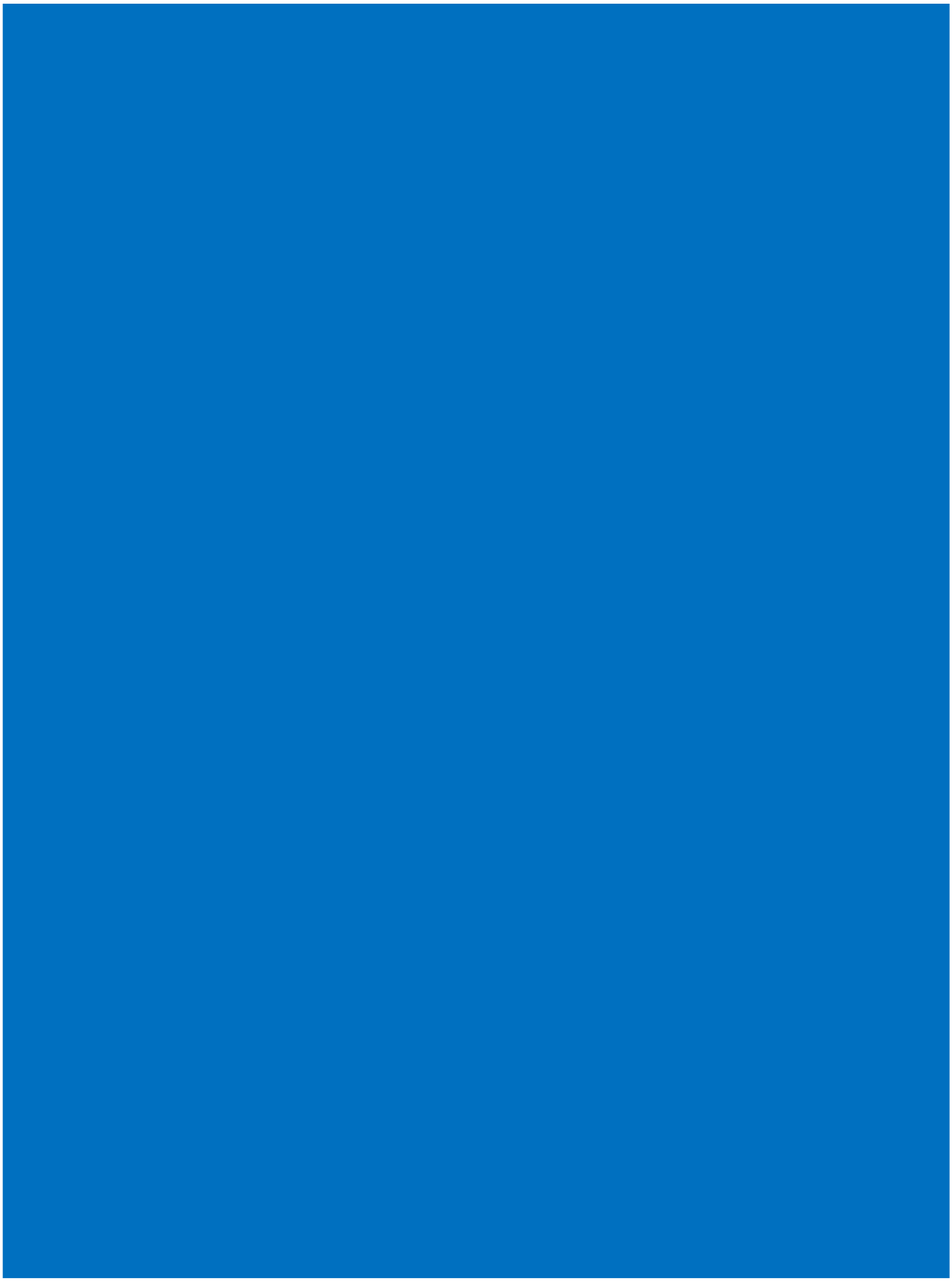

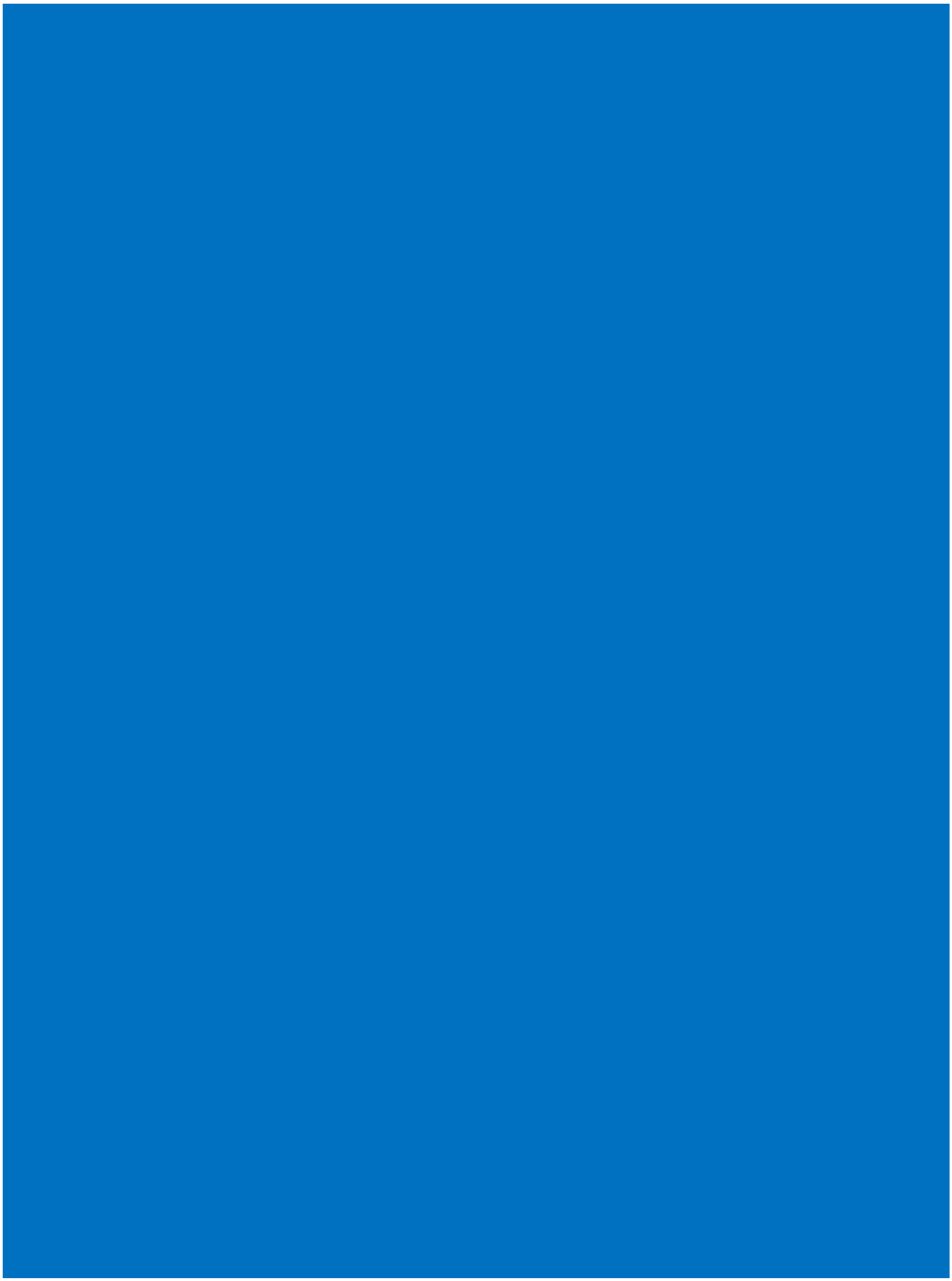

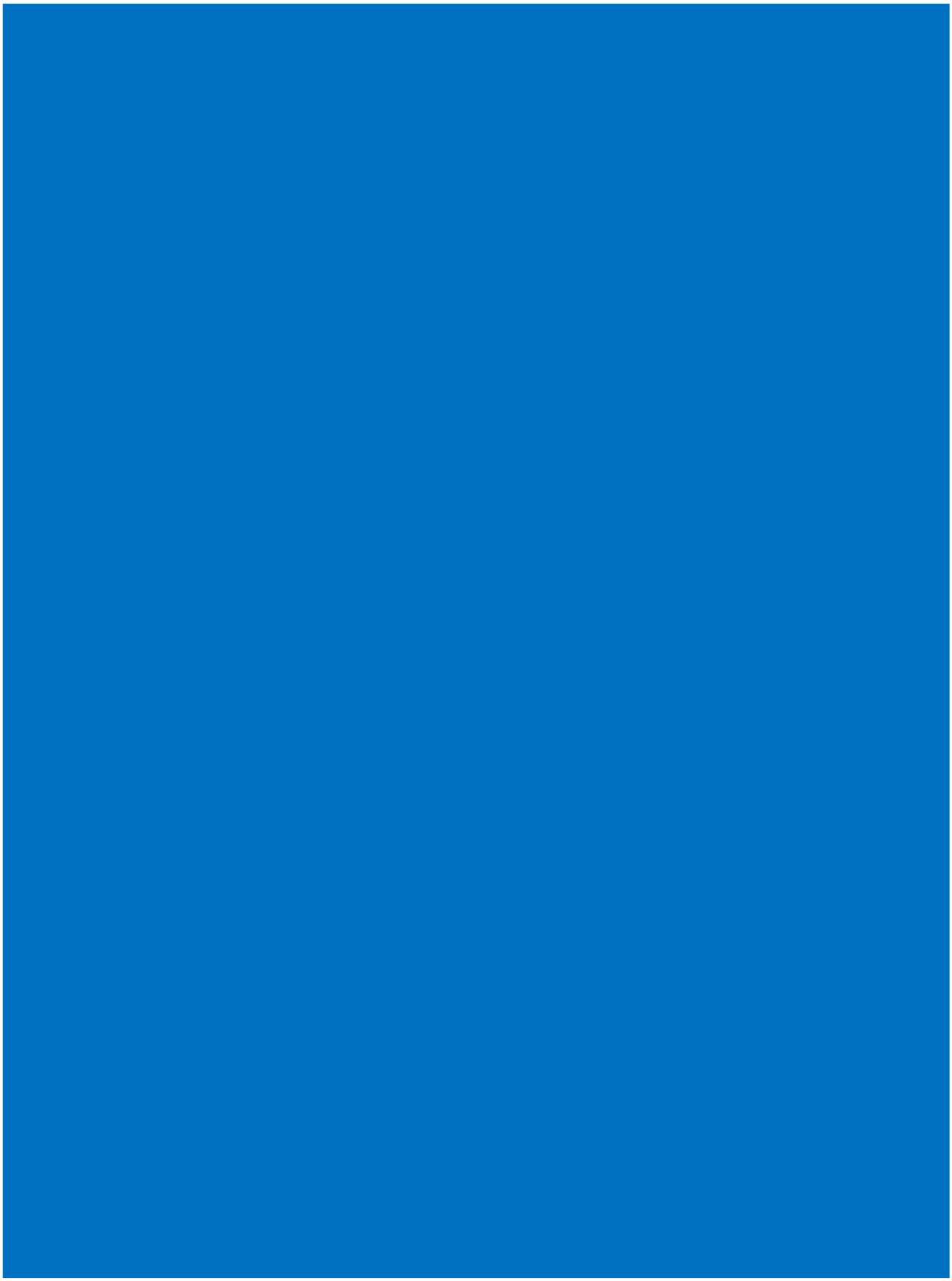

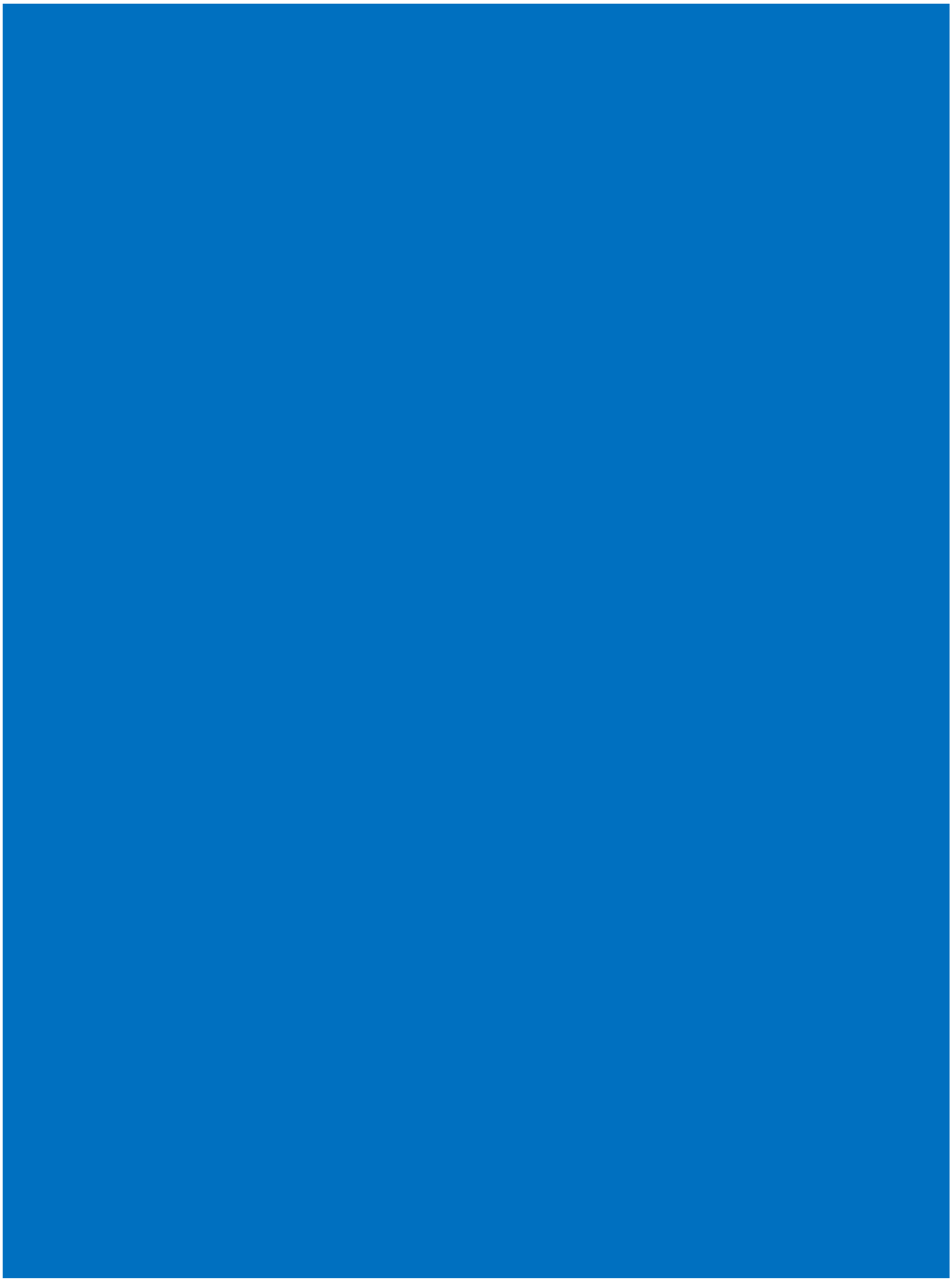

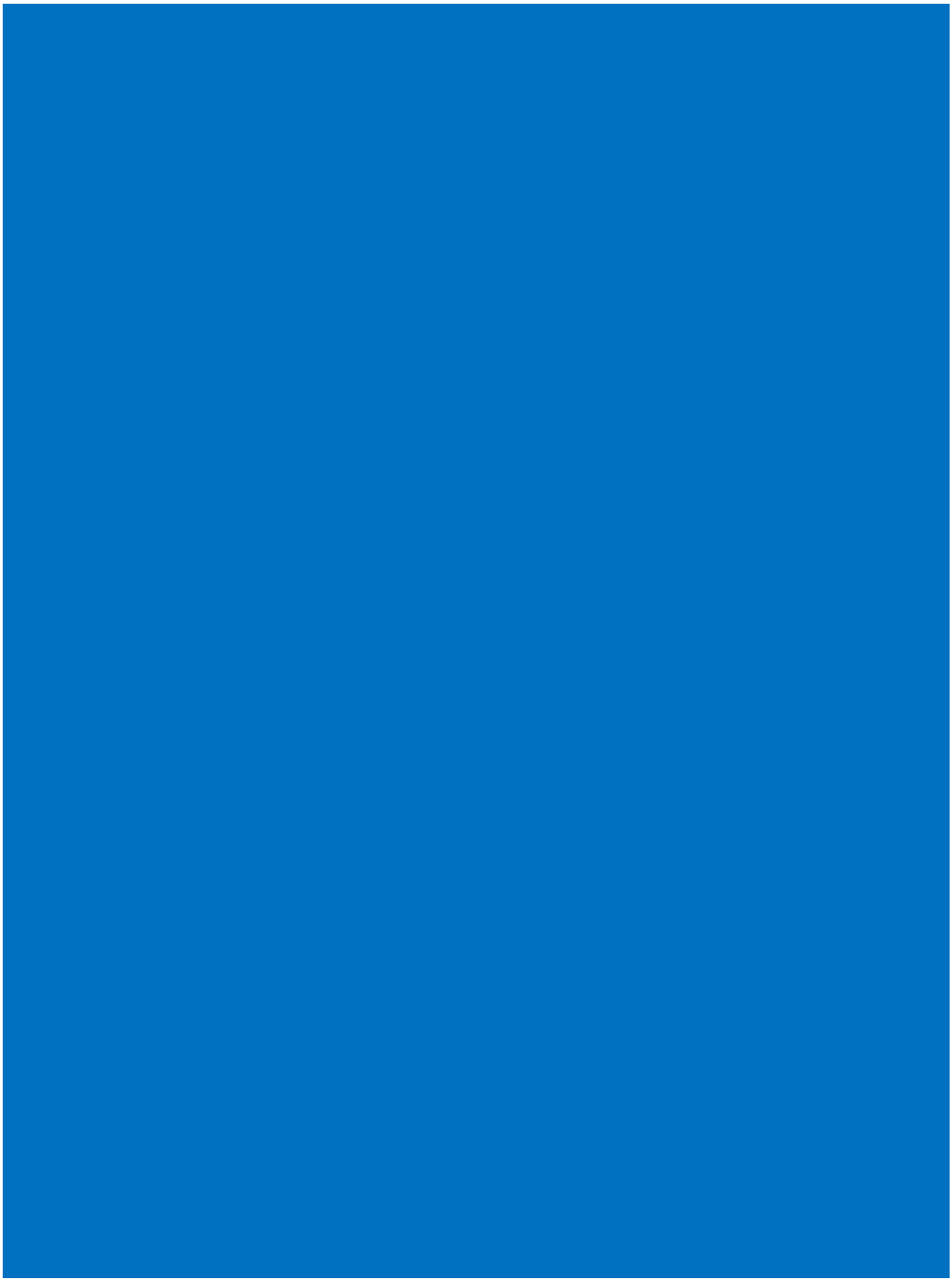

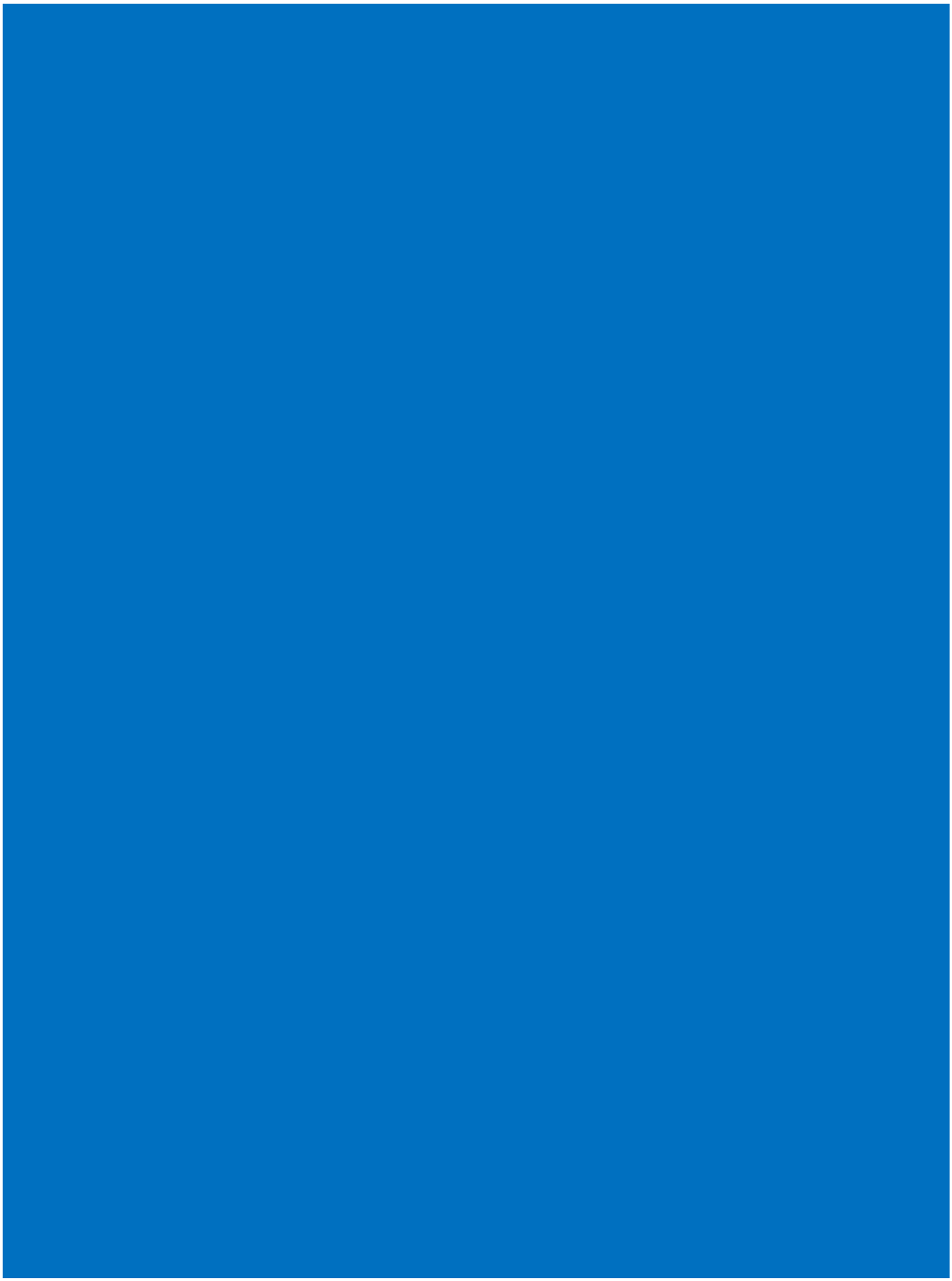

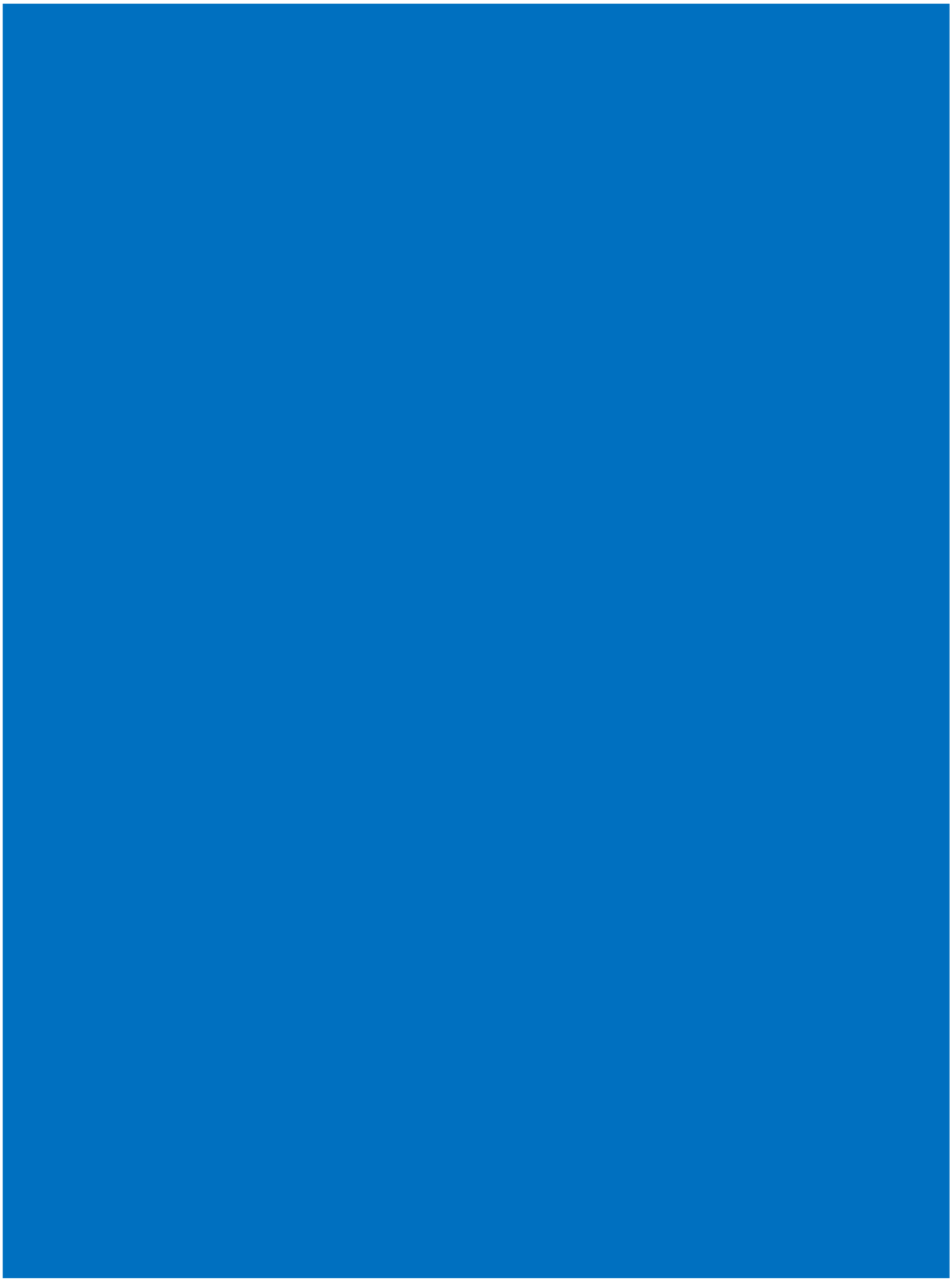

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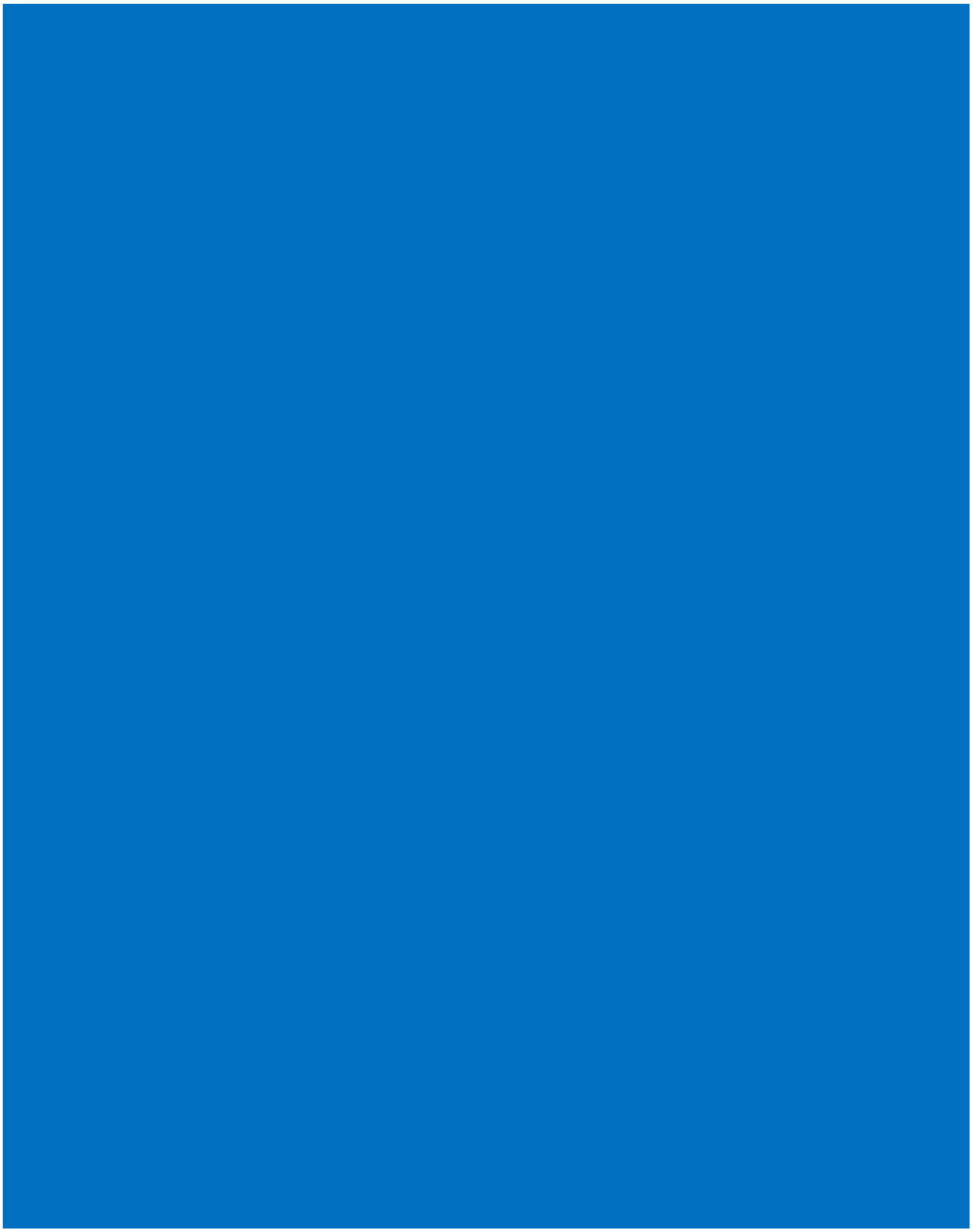

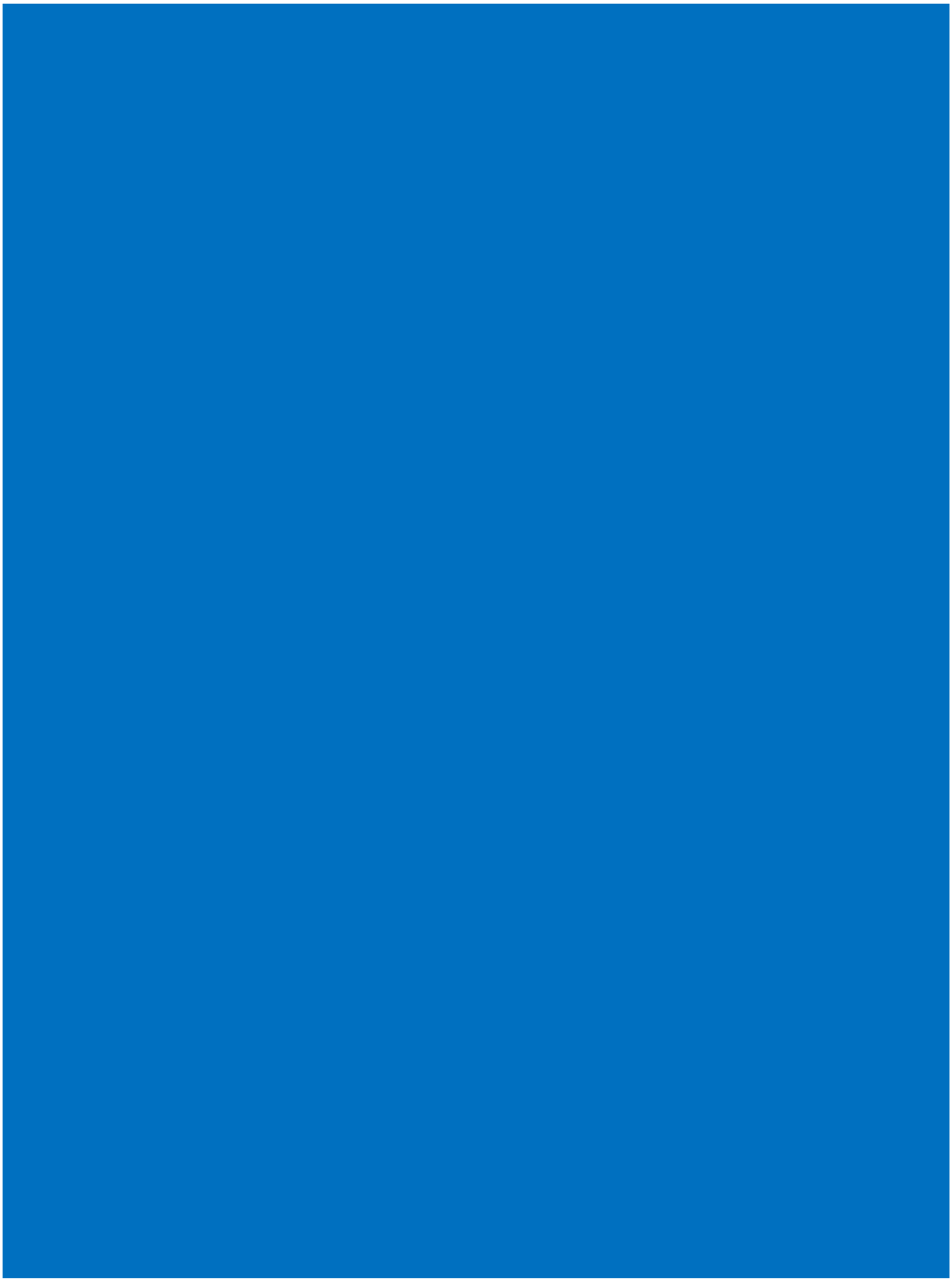

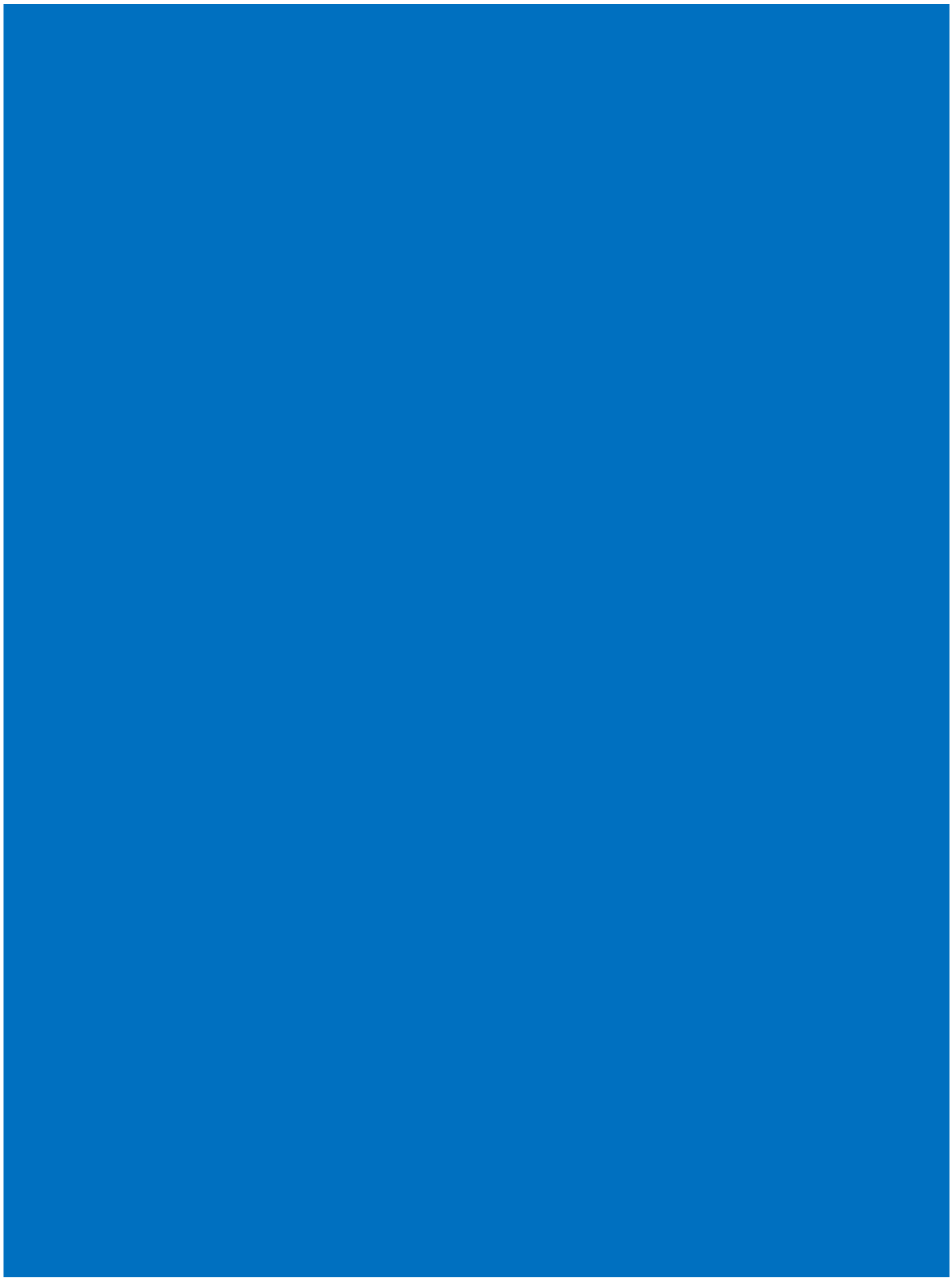

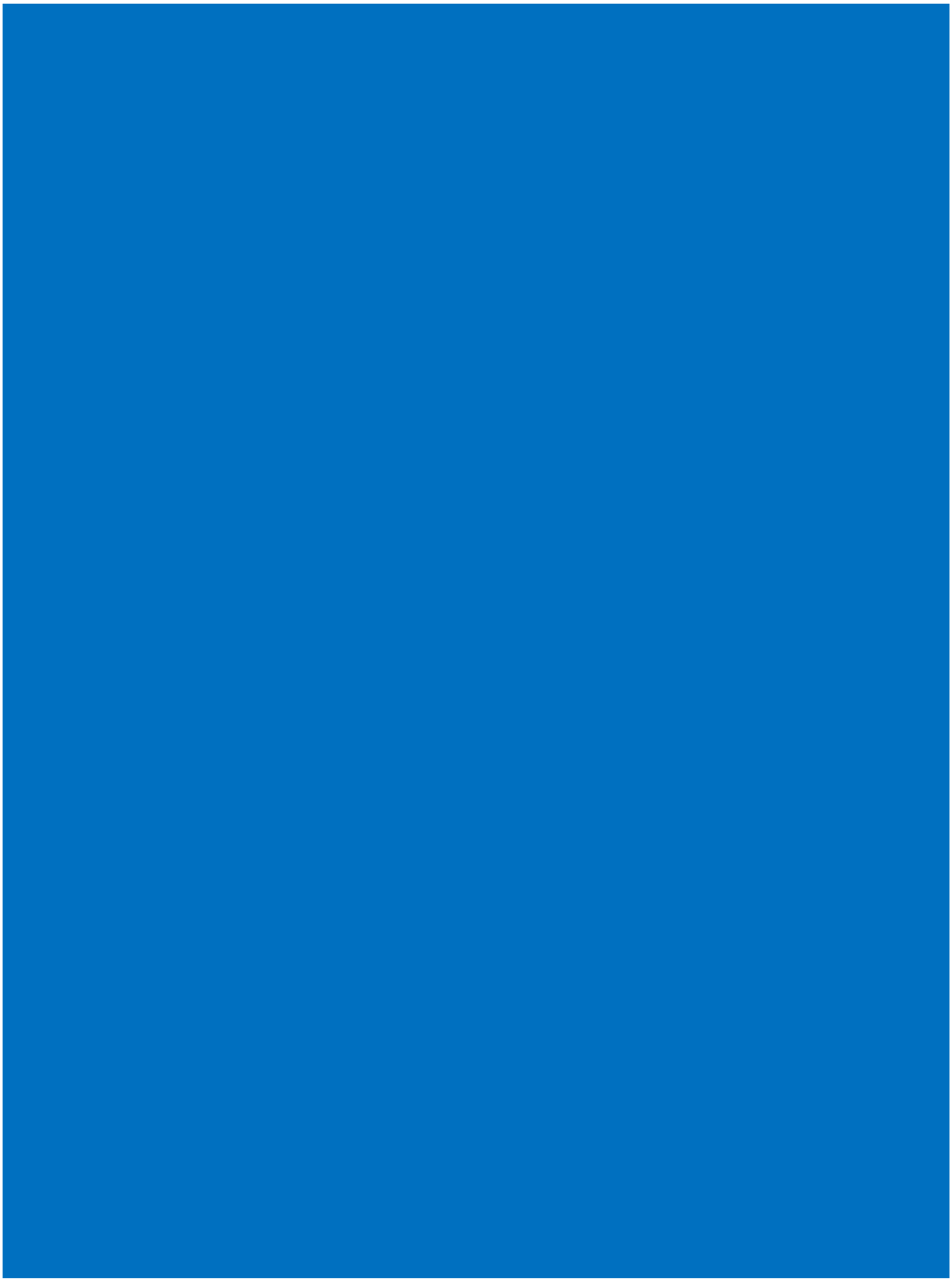

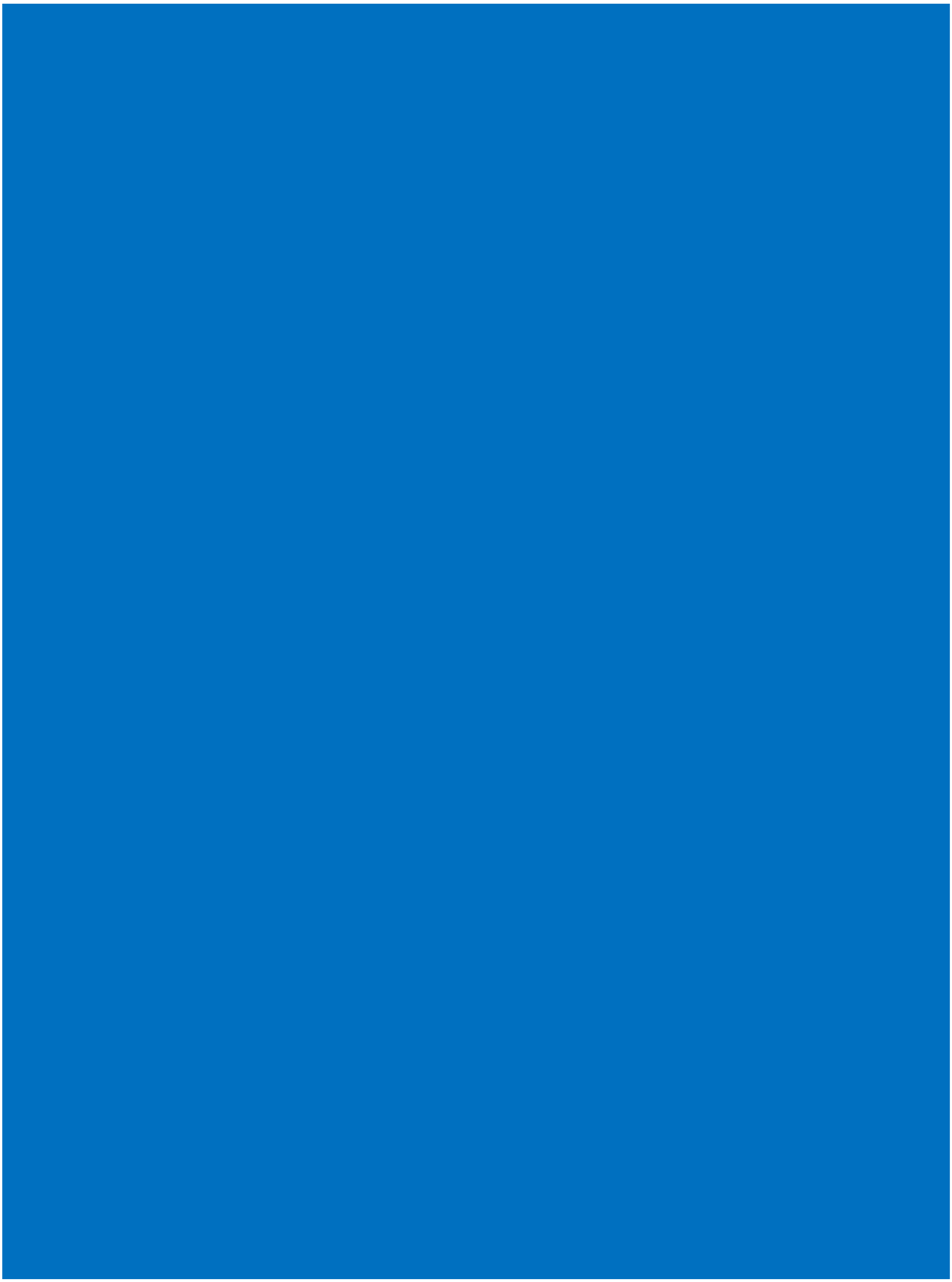

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EXTRACT FROM ACP-2017-079 STAGE 3 FULL OPTIONS APPRAISAL - APPENDIX 1

"ACP-2017-079 CAP1616 TABLE E2 - DESIGN OPTION 3

Group	Impact	Level of Analysis	SaxaVord Response
Communities	Noise impact on health and quality of life	Monetise and quantify	DIRECT - The direct impact of noise due to vertical launch spaceflight activities at SaxaVord Spaceport was assessed in SaxaVord Spaceport AEE V2.1 Assessment of Environmental Effects dated 30 Sep 22 submitted to the CAA as part of Space Industry Act 2018 licensing activities. Volume II Chapter 8[40,41] considers noise and vibration. In addition, Volume IV Appendix 8.1 contains a copy of a report commissioned by SaxaVord from Blue Ridge Research and Consulting LLC (BRRC) titled "Noise Study for Launch Vehicle Operations at Shetland Space Centre" dated 02/10/20. The parts of the AEE related to noise (including the BRRC report) are external to this document but have been submitted previously at Stage 2. Prediction of noise associated with launch vehicles (LVs), including static engine tests and launches, has been undertaken by BRRC. BRRC is an acoustical engineering consultancy focused on critical noise and vibration challenges for aerospace, aviation, and US Department of Defense projects. With experience from more than 250 civilian and military noise studies, BRRC's team of acoustical engineers is recognised as a trusted advisor to public, private, and academic clients in the space industry around the world. BRRC utilise RUMBLE noise modelling software as recognised in CAP1766. In advance of the CAA publishing a guidance document on environmental assessment requirements for space ACPs, SaxaVord has referred to the following: - Guidance to the regulator on environmental objectives relating to the exercise of its functions under the Space Industry Act 2018. • *"Guidance to the regulator on environmental objectives relating to the exercise of its functions under the Space Industry Act 2018"*. - Air Navigation Guidance 2017. • *UK Air Navigation Guidance 2017*.

40. ITPEnergised (2022), "*SaxaVord Spaceport (ITPEnergised) AEE*", V2.1, dated 30 Sep 22. Chapter 8 (Noise and Vibration) of the AEE document was extracted and submitted to CAA to support Stage 2. Available at https://consultations.caa.co.uk/ (online). Accessed on 3 Apr 23.
41. SaxaVord Spaceport AEE is currently under evaluation by the CAA's Commercial Space Regulation team; therefore, results for environmental impacts from direct space launch events presented in this appendix and the wider ACP may be subject to change following the CAA's evaluation.

Group	Impact	Level of Analysis	SaxaVord Response
Communities	Noise impact on health and quality of life (contd)		- Additional guidance under s70(2)(ca) Transport Act 2000: Carrying out air navigation functions for the purpose of spaceflight activities. Date 16 Sep 21. • *"Additional guidance under s70(2)(ca) Transport Act 2000: Carrying out air navigation functions for the purpose of spaceflight activities"*. The following analysis is, therefore, presented: - "When assessing distinct and infrequent noise, such as rocket noise, measures of single events such as the maximum noise level (LAmax) and the sound exposure level (SEL or LAE) are most appropriate". See AEE section 8.8. • The closest residence highest predicted level occurs during launches with a predicted level of 102 dBL_{Amax} [AEE 8.8.14]. Hearing damage limit 110 dBL_{Amax} • There are no residences within the predicted level contour 120 dBL_{max} [AEE 8.8.27]. Structural damage limit 120 dBL_{max} • The highest predicted level at Herma Ness occurs during a launch from Launch Pad 1 and is 87 dBL_{Amax} - "Where the rocket launch noise footprint could result in exposures in excess of 80, 85, 90, 95 and 100 dBLASmax, these areas will be published on suitable maps and used to communicate with local stakeholders". • This will be done for actual launches based on individual launch operator's LV data. • Modelled noise for a SaxaVord representative LV launch from SaxaVord Spaceport Launch Pad 1 (LP1) is at Figure 11, below.

Group	Impact	Level of Analysis	SaxaVord Response

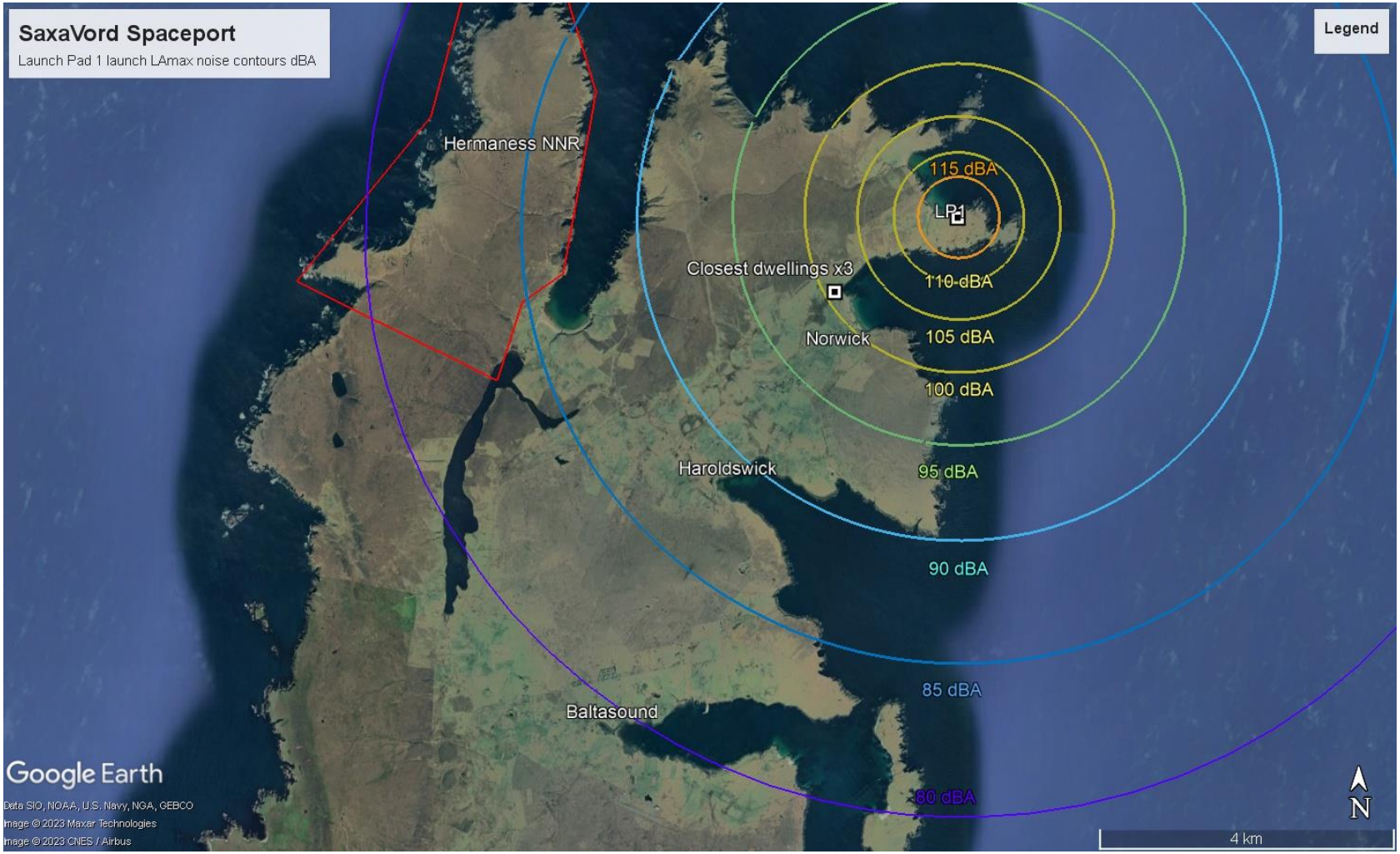

Figure 11 - SaxaVord Spaceport LP1 Launch LAmax Noise Contours dBA

<table>
<tr><th>Group</th><th>Impact</th><th>Level of Analysis</th><th>SaxaVord Response</th></tr>
<tr><td>Communities</td><td>Noise impact on health and quality of life (contd)</td><td></td><td>
- Sonic booms.
  - The sonic boom from launches is predicted to occur 60 km out to sea, away from populated areas; therefore, further consideration of air overpressure effects on structures and human receptors is not made [AEE 8.1.7].
- Sleep disturbance. See AEE 8.8.17-18.
  - Using the probability of awakening function given in the “Guidance to the regulator on environmental objectives relating to the exercise of its functions under the Space Industry Act 2018” and population data[42] aligned to noise level data from LP1 in Figure 11, above, gives the following data:
<table>
<tr><th>Location (Noise contour band)</th><th>Input value dB L_{Amax}</th><th>$P_{awakening}$</th><th>Population</th><th>Number of awakenings</th></tr>
<tr><td>Closest residences</td><td>102</td><td>0.17</td><td>8</td><td>1</td></tr>
<tr><td>100-95</td><td>100</td><td>0.17</td><td>32</td><td>5</td></tr>
<tr><td>95-90</td><td>95</td><td>0.16</td><td>94</td><td>15</td></tr>
<tr><td>90-85</td><td>90</td><td>0.15</td><td>40</td><td>6</td></tr>
<tr><td>85-80</td><td>85</td><td>0.15</td><td>130</td><td>19</td></tr>
<tr><td></td><td></td><td>Totals</td><td>304</td><td>46</td></tr>
</table>
Table 4 - Sleep Disturbance
  - For any one night launch it is estimated that 46 people out of a local population of 304 will be awakened
  - For the closest residence the noise level will have dropped back to baseline ambient level approximately 200 seconds after the launch (AEE 8.8.9).
  - On any one night, it is anticipated that there will be only one launch event of short noise duration (200 seconds at the closest residence). Furthermore, due to the low number of night launches expected across a year (approximately 10) this will further reduce the likelihood of any adverse effects on health due to night-time awakening.
  - Given the proposed frequency of launches and the short duration of the noise events associated with launches, and with reference to the 2006 Basner study which states that restricting additional awakenings due to aircraft noise to a maximum of one event per night is anticipated to have no adverse effect on human health, adverse effects associated with sleep disturbance due to night-time launches are considered to be minimal.
</td></tr>
</table>

42. Technical note ACP-2017-079 5 Apr 23 V1.0.

Group	Impact	Level of Analysis	SaxaVord Response
Communities	Noise impact on health and quality of life (contd)		INDIRECT - When the airspace is active no aircraft will be permitted to overfly or fly adjacent to the communities local to the spaceport. Hence, the indirect impact of aircraft noise on the local community due to the proposed airspace change will be no worse than the baseline condition. See Paras 56-60, above, for assessment of "Re-route Indirect Noise Impact from Airspace Activation". The activation of Design Option 3 is not considered a material change to "routes and/or traffic patterns … below 7,000 feet (above mean sea level)"; similarly, this does not precipitate a corresponding change in concomitant noise impacts. There is no requirement to monetise noise impacts as per the "Additional guidance under s70(2)(ca) Transport Act 2000".
Communities	Air quality	Qualitative or monetise and quantify, depending on the scope of the proposal	DIRECT - See SaxaVord Spaceport AEE V2.1 Assessment of Environmental Effects dated 30 Sep 22 submitted to the CAA as part of Space Industry Act 2018 licensing activities. The Non-Technical Summary (NTS) of this AEE has been submitted previously to support Stage 2. See Shetland Space Centre AEE Non-technical Summary, Chapter 11 and Chapter 16, specifically, Para 1.7.4: "Launch event emissions are predicted to have no perceptible impact at any identified receptors under prevailing wind directions. The maximum predicted impact at a sensitive receptor is predicted to occur with north-easterly winds which occur typically for less than 10% of the year. The maximum predicted 8-hour concentration of CO is 28% of the AQS. Emissions from launch events are therefore considered to have an effect of negligible significance on air quality, therefore resulting in no likely significant effect." INDIRECT - Not applicable; traffic data shows that there is negligible flying activity at or below 1000ft AMSL on the Shetland Islands. Design Option 3 does not, therefore, impact either traffic dispersion or total aircraft emissions below 1,000feet AMSL (CAP1616, Page 157, Appendix B, Para B14). Consequently, there is no corresponding impact on air quality associated with the activation of Design Option 3. Given the negligible traffic operating at 1000ft or below within the vicinity of the SaxaVord site, the extensive modelling required to monetise any variance in such a negligible number of aircraft movements is disproportionate.

Group	Impact	Level of Analysis	SaxaVord Response
Wider Society	Greenhouse gas impact	Monetise and quantify	DIRECT - A planning application for the Proposed Project was lodged with Shetlands Islands Council in Jan 21 and planning permission granted on 30 Mar 22 (document reference 2021/005/PPF). An environmental impact assessment was undertaken as part of the planning application for the Proposed Project and an Environmental Impact Assessment Report (EIAR) produced. Document reference: ITPEnergised (January 2021) *"Shetland Space Centre Environmental Impact Assessment Report (3148_1)"*. EIAR (with the rest of the planning documents) remain available online[43]. The chapter of the EIAR related to climate change (Chapter 15[44]) was extracted and submitted previously to support Stage 2; specifically, see Para 15.8.18: "Launch campaigns will directly result in up to 764 tCO2e annually, as the rocket engines consume RP-1 fuel which has a high carbon content. The site will have capacity to support 30 launches per year, each generating an average of 25.45 tCO2e" 764tCO2e x $93.93/tonne[45] = $71,762.52 This is based on a typical liquid oxygen and kerosene low earth orbit capable launch vehicle that may launch from SaxaVord. This is a limiting case as it is expected that not all of the 30 launches in a year will be of launch vehicles this large. SaxaVord acknowledges that fuel technologies are constantly evolving and will encourage spaceport users to implement the use of propellants that are less harmful to the environment into their operations. INDIRECT - The most limiting case activation of Design Option 3 at the peak hour of the peak day in the traffic sample on 30 instances (i.e. SaxaVord launches) could precipitate an annual impact of an additional 341tonnes of CO2e. See Paras 37-41, above, "Annual Traffic Re-route, Fuel Burn and CO2e Impact Assessment". 341tonnes x $93.93/tonne[46] = $32,030.13 Monetisation of Design Option 3 impact on CO2e will be between the extremities of Baseline (i.e. no change) and the most limiting case activation of Design Option 3; the total monetised additional direct and indirect impact cost of CO2e could be up to $103,792.65.
Wider Society	Capacity/resilience	Monetise and quantify	Not applicable; Design Option 3 would not impact the capacity/resilience of the wider UK airspace infrastructure.
General Aviation	Access	Monetise and quantify	Not applicable; Design Option 3 would have a negligible impact on the minimal general aviation operations in Unst.
General Aviation/ commercial airlines	Economic impact from increased effective capacity	Quantify	Not applicable; Design Option 3 would not impact forecast increase in air transport movements and estimated passenger numbers or cargo tonnage carried.

43. Shetland Islands Council (2023), "*2021/005/PPF | Vertical launch space port including launch pad complex, satellite tracking station, assembly and integration hangar buildings, with associated security fencing, access, servicing and infrastructure | Land at Lamba Ness, Unst, Shetland*" (online). Accessed on 4 Apr 23.
44. EIA Chapter 15 (online). Accessed on 4 Apr 23.
45. carboncredits.com (2023) (online). Accessed on 16 Mar 23. BBC News - Market Data (2023) (online). Accessed on 16 Mar 23. €1.00 = $1.0613.
46. *ibid*.

Group	Impact	Level of Analysis	SaxaVord Response
General Aviation/ commercial airlines	Fuel burn	Monetise and quantify	The most limiting case activation of Design Option 3 at the peak hour of the peak day in the traffic sample on 30 instances (i.e. SaxaVord launches) per annum could precipitate an annual impact of an additional 107tonnes of fuel burn. See Paras 37-41, above, "Annual Traffic Re-route, Fuel Burn and CO2e Impact Assessment". 107tonnes of aviation (jet) fuel x $862.74[47] = $92,313.18 Monetisation of Design Option 3 impact on fuel burn will be between the extremities of Baseline (i.e. no change) and the most limiting case activation of Design Option 3 shown here.
Commercial airlines.	Training costs	Monetise and quantify	Not applicable. Airspace reservations and their management, by both pilots and ANSPs are a routine occurrence in aviation; Design Option 3 would not impose an additional training burden on commercial airline operations.
Commercial airlines	Other costs	Qualitative	Not applicable; Design Option 3 would not impose quantifiable other costs on commercial aviation.
Airport/Air navigation service provider	Infrastructure costs	Monetise and quantify	Not applicable. Airspace reservations and their management, by both pilots and ANSPs are a routine occurrence in aviation. Design Option 3 would not impose a change in ANSPs' infrastructure.
Airport/Air navigation service provider	Operational costs	Monetise and quantify	Not applicable. Airspace reservations and their management are a routine occurrence for ANSPs. Design Option 3 would not impose a change in ANSP operational costs.
Airport/Air navigation service provider	Deployment costs	Monetise and quantify	Not applicable. Airspace reservations and their management are a routine occurrence for ANSPs. Design Option 3 would not impose a retraining and deployment cost burden on ANSPs.

Table 5 - Table E2 Guide to Expected Approach to Key Analysis for a Typical Airspace Change

47. IATA (2023), "*Jet Fuel Price Monitor*" (online). Accessed 16 Mar 23. Price point: 10 Mar 23.

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ACP-2017-079 CAA AERONAUTICAL DATA APPROVAL TEMPLATE

The ACP-2017-079 CAA Aeronautical Data Approval Template has been submitted separately.

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