

Shadow Study Report

Proposed Hotel Development

**144 & 176 John Street
Niagara-on-the-Lake
Ontario**

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144 & 176 John Street

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1.0 Introduction

Purpose of the Report:

The purpose of this report is to demonstrate the effect of the proposed development of a 6- storey Hotel and Conference Building upon the current location and upon adjacent properties. This is done by using a computer-generated Shadow Diagram, which generates the Shadow Pattern which is cast upon the ground by buildings upon adjacent properties. The study conforms to the Dates and Times set out typically for Shadow studies in Southwestern Ontario Municipalities. These can be found in Site Plan Standard “Design Reference Notes” or in Standards for Shadow Studies.” This report is a revision from a previous Shadow Study Report prepared in November 2017 as result of changes in the Hotel massing and changes in the location of the hotel and the maintenance building.

Description of the Proposed Development:

The existing land parcel is an established former estate property of approximately 53,806m² (13.29 acres) of area coverage. 300 metres (984 feet) of its frontage is onto municipally-owned John Street and 122 metres (400 feet) extends along municipally-owned Charlotte Street. Of the site area approximately 30,736m² (7.59 acres) of the land will remain in an “Open Space” use as defined by Town by-law 4511-11 where it was identified as a heritage conservation space. A substantial percentage of the “Open Space” consists of treed areas with a variety of deciduous and coniferous species, some trees of measured height exceeding 24 metres (78 feet). Combined with the environmental conservation mapping areas that follow the path of the One-Mile Creek also containing mature tree stock, well over 60% of the site is covered by a canopy of trees that have a conservative average height of 13 metres (43 feet) above a proposed finished floor height datum elevation used for this study. This canopy is well established at the boundaries of the property adjacent to neighbouring residential properties. The shading created thereby from a pre-existing natural condition shall be noted later in the evaluation for the reader.

There are three existing buildings on the site that would remain. Because they pre-date neighbouring development of residential houses, they have not been specifically studied for outside impact. Combined these buildings occupy approximately 1,605 m² of land coverage or approximately 3 percent of the land parcel area and are all three are located on the site in positions that are closer to any new building structure above grade. A summary of existing building massing is provided in the following chart:

Existing Building Name	Footprint Area		Maximum Bldg. Height		Average Height of Building Mass	
	sq. metres	sq. feet	metres	feet	metres	feet
1 Randwood Mansion Building	1037.59	11168.56	13.00	42.65	10.00	32.81
2 Devonian House	404.31	4351.96	11.50	37.65	9.60	31.50
3 Coach House	162.80	1752.39	7.00	23.00	5.00	16.40

For purpose of clarity, please note the following summary of new building area and heights. The only buildings that create a realistic new shadow impact are the proposed hotel / conference centre (2) and a new grounds maintenance building (1).

New Building Name	Footprint Area		Maximum Projection		Assumed Maximum Height of Building.	
	sq. metres	sq. feet	metres	feet	metres	feet
1 Maintenance Bldg.	307.42	3309.04	5.50	16.40	5.20	17.06
2 Hotel & Conference Bldg.	2563.78	27596.29	23.00*	75.45*	22.00*	72.18*
3 Linked Covered Walkway	92.14	991.78	6.50**	21.35**	4.60**	15.09**
4 u/g parking facility	5706.67	61426.08	2.80 ***	9.18	0.01	0.03

Chart Footnotes:

* Data refers to the highest elevation point of the building including maximum anticipated height of mechanical equipment. In the current re-design, the six-storey portions of the hotel block (#2) has an assumed maximum height at 22 metres (72.18 ft.) from adjacent grade. The now reduced six-storey floor area is also substantially stepped back horizontally from the face of east and west building elevations and is defined by three centralized flat roof areas featuring at its perimeter, an architectural cornice and forming a parapet higher than the flat roof inside these areas. The proposed rooftop mechanical equipment, representing the highest projected height in building #2 of the chart above, are likely to be centred within the corniced roof areas and therefore poses no shadow impact higher than the assumed height of building mass. The shadow modelling found no point where roof equipment added to shadow projections of the main block configuration.

**Data refers to the height of a proposed gazebo roof feature on what is otherwise a flat roof walkway between buildings and the assumed maximum ht.

*** Data refers to the area of the site that proposes a fully buried and landscaped underground structure that is to be flush with or transitional to, the existing adjacent site contours except in the case of the west extent of this structure where it shall have terracing incorporated with new landscaping that may locally elevate the first 3 to 4 metres horizontally over the existing adjacent site contour though would not have a net increase in height to the site greater than the assumed maximum height figures in the chart column above. The assumed maximum height from adjacent grade of the parking structure is an isolated condition occurring only at the vehicle access ramp, which is recessed into the existing adjacent grade between the hotel block and the coach house thereby representing no shadow impact whatsoever in this study.

The limitations of shadows cast on other new low-height building mass discounts further study because they are lower than adjacent buildings and their peak. This applies to the linked covered walkway (#1) and the u/g parking facility (#4) when factoring in the position or the average height of building mass in each instance. Therefore, the study will present in greater detail only the shadow data pertaining to the new hotel / conference building and the new maintenance building as relevant to the study objectives.

The proposed hotel/conference building will be located within a central clearing of the site between the existing Randwood mansion and the coach house buildings. The hotel/conference building is slightly set back from John Street by comparison to the mansion house.

Neighbouring Properties:

Although our study has used accurate geodetic coordinates for the sun study, to simplify the terminology our report will consider the John Street frontage as the north boundary of the property, Charlotte Street frontage as the west boundary of the property and so on.

Neighbouring Properties cont'd.....

To the East:

The immediate adjacent property is owned by the applicant and known as 200 John Street. The 20-metre wide portion of 200 John Street extends along the entire 195 metre depth of the subject property and has no buildings within it (existing or new). This strip of land is heavily treed consistent with the same levels of canopy height found on the subject site.

Further to the east (not adjacent) is 210 John Street, which an estate property containing a heritage mansion and a collection of accessory buildings on approximately 10 acres of land and is of similar lot depth compared to the subject property. The 2 ½ storey house is centred on the property more than 60 metres away from its west boundary. This property contains heavily treed areas along its west boundary. This house is more than 150 metres from the proposed 6-storey hotel block with respect to the distance from the highest potential shadow projecting mass.

To the West:

Approximately 204 metres of West boundary is adjacent to private single-family homes or town homes while the balance of the subject lands front on Charlotte Street. While addresses 1, 2, 3,4,5,6 & 7 Christopher Street have rear yards that fully, or partially, back onto the subject property, 5 Christopher Street and 6 Christopher Street are closest to the new development buildings. 5 Christopher Street is a one-storey home with attached garage and is approximately 3 metres (10 feet) away from the rear property to the house at its closest point. The house would be, at a minimum, 72 metres from the proposed five-storey face of the hotel block with respect to the distance from the highest potential shadow projecting mass. 6 Christopher Street is a 2-storey home with attached garage and is approximately 17 metres (56 feet) away from the rear property line to the house at its closest point. Though higher in building height than their neighbour, this house would be at a minimum 73 metres from the proposed 5-storey hotel block face with respect to distance from the highest potential shadow. It is approximately 48.5 metres from the proposed one-storey maintenance building with respect to the distance from its potential shadow.



Figure 1: 5 & 6 Christopher Street single-family homes. Note Existing Trees on subject property and rear yards

To the West cont'd.....



Figure 2 : Aerial View of Christopher Street with No Deciduous Foliage

Rear yards of town home units 44 and 40 on Weather Stone Court are not directly adjacent to the subject property and are positioned south of the proposed location of the maintenance building with no resulting shadow effect.

To the North:

John Street, across from the subject property is has no private lands or buildings that could be impacted by shadows if exposure to shading were to occur. The most adjacent lands are owned by Parks Canada and form part of the area known as the “Commons”. The lands are randomly treed at the boundary along John Street with predominately mature deciduous stock and there is a diverging laneway more than 140 metres from the Street that is lined with mature deciduous trees. The remaining land is generally flat long-cut grass. It is 120 metres from the proposed 6-storey hotel block with respect to the distance from the highest potential shadow projecting mass to the edge of John Street.

To the South:

The immediate adjacent property to the south is owned by the applicant and known as 200 John Street. This property is under a separate development application that is intended for residential development.

2.0 Methodology

Bylaws of the Town of Niagara-on-the-Lake govern property development. One of the criteria being analysed under the broader application, is the requirement that the proposed development address the bylaw requirements and that any development proponent make materials available to the Municipality for evaluating impact caused by a development application.

Specifically, this study is addressing the issue of new building height, massing configuration and location on the site as to the effect of the shadows created upon neighbouring properties and within the subject property itself as a result.

This shadow study also provides shadow diagrams for 3 periods of the day as sample of temporal sun movement and angle with seasonal influences. The examples are representative of different shadow patterns cast over the course of the day as the sun arcs through the sky and determines the extent of shading periods.

Because the Sun changes its angle of arc, our study also analyses the typical shadow patterns, which reflect the solar solstice periods over the course of the year, and represent the highest, the mid and lowest points of the sun over the year to show variances.

The findings of a computer-generated simulation assimilate data variables as to building height, terrain, distance to objects and models shadow length created by solar angle and solar rotation over the entire course of the typical day from dusk to dawn, collecting this in video form. The written study summarizes the impact over the periods of study in sample snapshots and presents this data in graphic form. The acceptable standards of time during the day for these samplings are 9:30 am, 12:30 pm and 3:30 pm.

Location Factors

In Appendix “A” the shadow diagrams contained within that section illustrate the maximum shadows to be created at specific times and dates and the chart in Appendix “B” provides the technical data. The analysis was conducted based upon a geodetic location of 43 degrees, 14 minutes and 39.29 seconds North and 79 degrees, 4 minutes and 20.28 seconds west, which is central to the subject property and specifically on the area of the land parcel where the proposed new buildings would be located.

Building Height Assumption

At the time of the study, the proposed buildings the analysis will base the shadow correlation of a building with the assumed maximum heights of 22 metres above the geodetic ground level set for the finished ground floor level, established at 91 metres above sea level for this study. The study accounts for general terrain of the site and surrounding lands relative to the geodetic ground level as this will vary the shadow correlation including the ground floor height and relative height of adjacent existing buildings. The study also factors in the height of the building block that is less than the assumed maximum to give an accurate shadow map. The current building steps down from a six-storey to a five-storey configuration on flanking east/west sides and has terraced corners on the north face that are three-storeys in height, thereby reducing impact.

Sample Diagrams

The diagrams provided illustrate shadow patterns for 3 specific dates of the year.

The extrapolation of the sample shadow diagrams will assist the reader in understanding the typical shadow paths, which are cast in Spring, Summer and Winter periods. On each shadow plan the report will discuss the surface pattern for each of the dates and times and will identify characteristics of those shadows and the anticipated impact upon the immediate site and neighbouring sites.

All objects, including buildings and other site terrain, will cast a shadow as the sun rises and sets into the horizon during those first moments of incidence and will form transitional shadow during a period of approximately an hour after or before. The period of daylight including transition can range from approximately nine and one quarter hours in December to almost fifteen and a half hours in June. The sun will cover a transition arc in less time during the Summer by comparison to Winter but for purpose of a standard to determine relative day-time exposure to shading, the earliest sampling of shadow is taken at 9:30 am and the latest sampling is taken at 3:30pm (15:30).

Criteria for Determining an Impact

By way of priority, the report would weigh adverse impact of shadows as whether they firstly cast onto neighbouring private lands or public spaces. Upon review of the post-development model, if there are new shadows created in the initial findings, secondary analysis will compare the change caused by the development against the background of existing shading conditions and determine by what extent the region of the neighbouring site is being impacted. Specific concern would be identified for amenity spaces or predominantly pedestrian-utilized areas affected.

The third determinate on impact will be based on the amount of time daily, monthly and annually when any new shading caused by the proposed new buildings of post-development produce shade on impacted areas during relative day-time hours. If no shading occurs in the day-time hours and only occurs during transitional hours the impact is less. Shadow paths are cyclical and one can determine a percentage of additional shadow created, expressing this as a percentage of potential annual sunshine exposure. If a shadow is cast upon a neighbouring house for 2 percent of the year, that would represent approximately 55 to 64 net hours of potential reduced sun exposure under ideal weather conditions during the relative day-time hours, this would be of greater impact than a lower sun-angle exposure for 2 percent of the year occurring outside of the relative day-time hours, those periods nearer to dawn or dusk.

3.1 Shadow Study: Pre-Development

3.1.1 Winter Shadows: December 21st

Assumptions of shadows cast upon the site or from the site of the subject property are as follows:

- Sunrise at 7:45 am, Sunset at 4:43pm – approx. 8:59 hours daylight
- Single family homes including 5 and 6 Christopher Street to the west of the subject property will be cast in partial shadow from existing trees that bound the One-Mile Creek on both the subject property and rear yards of the same neighbouring properties. In addition to tree canopy shading the existing coach house casts a shadow on 5 Christopher Street within the backyard only during the month of December and only in early hours. The Randwood mansion will cast a shadow over the adjacent 200 John Street property but only during the last hour before sunset and only during the month of December.
- As the property is very large and because other existing buildings are located north, or east, and in the widest east-west cross section, no other pre-existing shading condition is noted.

3.1.2 Spring Shadows: March 21st & Fall Shadows: – September 21st

Assumptions of shadows cast upon the site or from the site of the subject property are as follows:

- Sunrise at 7:17 am, Sunset at 7:30pm – approx. 12:13 hours daylight in March and 7:02am sunrise, 7:14pm sunset – approximately 12:13 hours in September
- As encountered in winter conditions but with more foliage, Christopher Street to the west of the subject property will be cast in partial shadow from existing trees in early morning.
- No other shadows generated in Spring or Fall sun positions extend beyond the property boundaries.

3.1.3 Summer Shadows: June 21st

Assumptions of shadows cast upon the site or from the site of the subject property are as follows:

- Sunrise at 5:36 am, Sunset at 8:59pm – approx. 15:23 hours daylight
- No shadows generated in summer sun positions that extend beyond the property boundaries.

3.2 Shadow Study: Post-Development

POST DEVELOPMENT: (6-STOREY STEPPED MODEL) ANALYSING THE IMPACT OF THE SHADOW OF NEW HOTEL BUILDING AND ONE-STOREY MAINTENANCE BUILDING” ON THE PROPERTIES SURROUNDING THE PROPOSED DEVELOPMENT.

3.2.1 Winter Shadows: (as at December 21st.)

A summary of the winter shadow impact of the proposed development upon the subject property and surrounding area is as follows:

3.2.1A 9:30am (see Appendix 1 Page 1) The shadow length is approximately 110 metres. The morning sun in winter rotates only 116 degrees from east to west in approximately 9 hours. At this time of day, it is low in the sky (12.89 degrees altitude and 320.1 azimuths) and rises in the sky over vineyards and heavy treed areas whereby general shading factors are high and overlapping. Sunrise will be approximately 7:45 am and will arc 16 degrees by 9:30. Longest shadow length generated is 107 metres. No building shading on neighbouring lands from the hotel building occurs by 9:30am and after. The maintenance building will extend a 11-metre long shadow beyond the west property line of the subject land onto the neighbouring land where there are no buildings affected; This shadow diminishes by 10:00 am to within the subject property line boundaries.

3.2.1B 12:30pm (see Appendix 1 Page 2) The shadow length is approximately 54 metres. At this time of day, sun is highest in the sky (23.20 degrees altitude and 267.03 azimuths) and above all background obstacles. Longest shadow length generated is 54 metres. All shading cast by subject property buildings including the new buildings, falls well within the property lines. No building shading impact occurs on neighbouring lands.

3.2.1C 3:30pm (see Appendix 1 Page 3) The shadow length is approximately 123 metres. At this time of day, it is descending below mid-way point in the sky (10.02 degrees altitude and 226.23 azimuths). Longest shadow length generated is 125 metres. Although lower on the horizon than the 9:30am interval, all shading cast by all subject property buildings, including the new buildings, falls within the property lines and John Street. No building shading impact occurs on neighbouring lands within relative day time.

3.2.2 Spring Shadows (as at March 21st) & Fall Shadows (as at September 21st.)

A summary of the Spring/Fall shadow impact of the proposed development upon the subject property and surrounding area is as follows:

3.2.2A 9:30am (see Appendix 1 Page 4) The shadow length is approximately 41 metres. The morning sun rises at approximately 7:02am (September) (March) and evening sunset occurs at approximately 6:30pm (March). Longest shadow length generated is approximately 38 metres. At this time of day, sun arc is reaching a mid-point in the sky (31.66 degrees altitude and 324.91 azimuths) above the horizon clear of heavy treed areas. No building shading on neighbouring lands from the hotel building or the maintenance building will occur inside or outside of relative daytime.

3.2.2B 12:30pm (see Appendix 1 Page 5) The shadow length is approximately 22 metres. At this time of day, it is highest in the sky (46.13 degrees altitude and 268.75 azimuths) and above background obstacles. Longest shadow length generated is approximately 22 metres. All shading cast by subject property buildings, including the new buildings, falls well within the property lines. No building shading impact occurs on neighbouring lands inside or outside of relative day time.

3.2.2C 3:30pm (see Appendix 1 Page 6) The shadow length is approximately 37 metres. At this time of day, the sun is descending below mid-way point in the sky (30.63 degrees altitude and 213.50 azimuths). Longest shadow length generated is approximately 38 metres. Although lower on the horizon than the 9:30 interval, all shading cast by subject property buildings, including the new buildings, falls well within the property lines. No building shading impact occurs on neighbouring lands within relative day time.

3.2.3 Summer Shadows (as at June 21st.)

A summary of the Summer shadow impact of the proposed development upon the subject property and surrounding area is as follows:

3.2.3A 9:30am (see Appendix 1 Page 7) The shadow length is approximately 19 metres. Daylight savings is observed. The morning sun rises at approximately 5:36am and evening sunset occurs at approximately 8:59pm. Longest shadow length generated is approximately 18 metres. At this time of day, it is reaching a mid-point in the sky (49.81 degrees altitude and 344.63 azimuths) above the horizon. No building shading on neighbouring lands from the hotel building or the maintenance building will occur.

3.2.3B 12:30pm (see Appendix 1 Page 8) The shadow length is approximately 8.5 metres. At this time of day, it is highest in the sky (70.17 degrees altitude and 263.34 azimuths) and above background obstacles. Longest shadow length generated is approximately 8.5 metres. All shading cast by subject property buildings including the new buildings falls well within the property lines. No building shading impact occurs on neighbouring lands.

3.2.3C 3:30pm (see Appendix 1 Page 9) the shadow length is approximately 21 metres. At this time of day, the sun is descending but above mid-way point in the sky (46.59 degrees altitude and 191.40 azimuth). Longest shadow length generated is approximately 22 metres. Although lower on the horizon than the 9:30 interval, all shading cast by subject property buildings, including the new buildings, falls well within the property lines. No building shading impact occurs on neighbouring lands.

4.0 Shadow Impact

Summary of Impact by the proposed 6-Storey Stepped Hotel/Conference Bldg. and One-Storey Maintenance bldg.

4.1 The shadows cast from this proposed development are largest in the winter:

- The affect will be in the morning only.
- For a period of approximately one hour during the shadow rotation from south to north between sunrise (7:45am) to approximately 8:45 am, there is a possibility that the proposed hotel 6-storey stepped mass, in its proposed location, could cast a long shadow onto the side yard of 5 Christopher Street.

- All shading falls outside of the standard relative day time. This cycle of shadow casting would only appear to occur for approximately 10 days each side of the December 21st Solstice date used for our study.
This equates to less than one half a percent of annual daylight event or approximately 20 hours per year of shadow coverage and all during low angle conditions. This has increased slightly from November shadow modelling results by reason that the massing of the building, although more articulated, is set back from the John Street property line and will cast a shorter shadow that is positioned further south. The current stepped massing design now at only a five-storey height (approx. 18 metres or 59 feet) and its reduction of a cornice feature at the perimeter of east and west elevations, both being changes since the November 2017 shadow study, generates less net shadow into the east and west side yards.
- There is a shadow cast over the south corner of 6 Christopher Street and 7 Christopher Street backyards caused the new maintenance building placement. This occurs during the shadow rotation from south to north between sunrise (7:45am) to approximately 10:00 am and for roughly one and one quarter hours duration. This shadow path would only occur for approximately two weeks in mid-December and slightly over one-third of a percent of annual daylight event or approximately 14 hours per year of shadow coverage and all shading occurring during low angle conditions. There are no shadows falling upon adjacent houses in this study period caused by the maintenance building. Since the November study, the subject maintenance building has been set back from the property by an additional 4 metres and this translates into less impact.
- With the level of vegetation that is screening the shadow path of pre-development and what is proposed in the way of screening for post-development landscaping, the impact of this event is quite low.

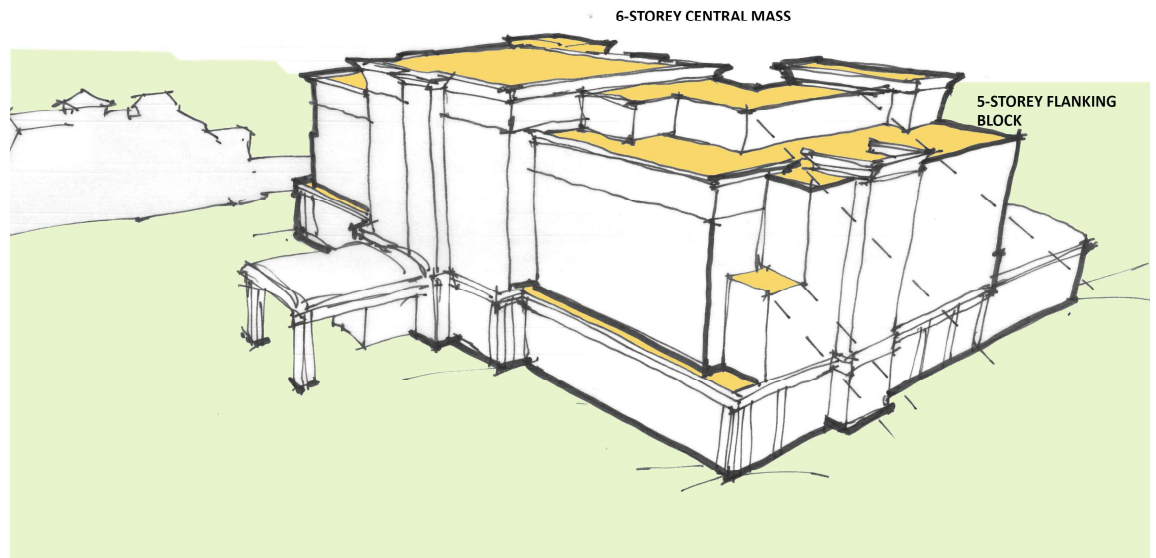
4.2 The shadows cast from this proposed development for remaining Spring Summer and Fall:

- There are no shadows falling upon adjacent houses or neighbouring property surfaces in this study period.

4.3 General Comment Regarding Shadow Affect based upon the Shape of a Building:

- The shadow effect of a “thinner” or “stepped” building has less impact than a “wide” building. A pyramid is an ideal shape for reducing the ratio of shading to overall mass. The shadow of a thinner building falls “upon” a property for a shorter period and effectively “passes over” a building and property more quickly than a wider building and therefore has less shadow impact.

- As this proposal is effectively to create a tapered building effect or building with a 1-storey plinth which is 6-storeys in height at its “core” and wider at its “base” is considered a “tapered” building with less shadow impact than a lower and wide building. In the revised study model, this has been further tapering of the hotel mass by reducing the east and west flanking blocks to 5-storeys and by reducing the north-east and north-west corners of the block down to 3-storeys.



4.4 General Comment Regarding Buffers surrounding a Building:

- The development to the north is buffered by substantial, mature growth and, as noted in the information section of our report, there is surrounding tree canopy heights at an average of 13 metres (43 feet) contained within the limits of the shadow distances such that the development will receive very little if any shadow impact at any time of the day and only to a very minor extent as described herein during the Winter.

Robert Mackenzie, OAA, B.Arch, RAIC

Exc. V.P., Director of Corporate Development

APPENDIX A



Legend:

- South Abutting Property: owned by subject property owner and not part of this study
- Contoured Surface of Subject Project Lands and Adjacent Lands in One Metre Elevation Changes
- Property Boundary of Subject Project Study
- Outline of Shadow from New Buildings



Legend:

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Legend:



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Contoured Surface of Subject Project Lands and Adjacent Lands in One Metre Elevation Changes

 Property Boundary of Subject Project Study



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